PRELIMINARY ENGINEERING REPORT

ON

PROPOSED ALBERTA-MONTREAL CRUDE OIL PIPELINE

PREPARED FOR

HOME OIL COMPANY LIMITED

BY

DUTTON-WILLIAMS BROTHERS LIMITED

ENGINEERS - CONSTRUCTORS

CALGARY, ALBERTA

VOLUME IA

Energy
Exhibit no. CC-29-4
vol. 1-A
1958

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Calgary, Alberta

April 14, 1958

VOLUME IA

DUTTON - WILLIAMS BROTHERS LIMITED
ENGINEERS — CONSTRUCTORS
NORTH CANADIAN OIL BUILDING
CALGARY, ALBERTA

REPLY TO Project 3094

April 14, 1958

Home Oil Company Limited
304 Sixth Avenue West
Calgary, Alberta

Gentlemen:

In accordance with your recent instructions, we have prepared the attached Preliminary Engineering Report on the proposed Alberta-Montreal Pipeline crude oil system. We believe the report sufficiently examines the factors involved and adequately defines a system for planning purposes.

Conclusions

1. Under the conditions considered, the 30-inch "Southern Route" system appears to offer the most economical transportation and also the best balance between investment and operating cost.

   In evaluating the alternatives, a number of possible sizes of the main pipeline and possible routes were considered. A comparison of the recommended system with one of the possible alternate routes is made in the report to illustrate the basis for the above conclusion. The capital requirements for the initial and tenth year of operation are summarized for the two systems compared, as follows:

Classification	Southern Route 1960	Southern Route 1969	Northern Route 1960	Northern Route 1969
Construction Costs	$307,500,000	$332,100,000	$342,300,000	$367,800,000
Line Fill	24,100,000	24,100,000	23,900,000	23,900,000
Interest during Construction	12,100,000	12,600,000	13,500,000	14,000,000
Working Capital	1,900,000	1,900,000	1,900,000	1,900,000
Financing Costs	7,800,000	7,800,000	8,400,000	8,400,000
	$353,400,000	$378,500,000	$390,000,000	$416,000,000

2. Based upon the capital requirements for the recommended system, the 30-inch Southern Route System, the "cost of service" during the fifth year of operation per barrel transported as projected in the report is 51.8¢. "Cost of service" in this case includes depreciation, interest, operating cost, return on investment and income taxes. We believe a normal tariff schedule for crude oil pipelines employing this amount as the primary transportation charge from Alberta to Montreal could be recommended and that earnings generated at this rate on the assummed average throughput will be sufficient to effect financing of the project.

Report Summary

1. The initial capital requirements for the recommended system amounts to approximately $353,400,000 of which $307,500,000 is attributable to cost of the installation.

2. The initial system consists of approximately

   1,919 miles of 30-inch Main Line
   100 miles of 26-inch gathering line
   71.5 miles of 16-inch gathering line
   73.5 miles of 10-inch gathering line

   1,700,000 barrels of steel tank storage
   35,000 installed horsepower in pumping facilities

3. The initial capacity of the system is 253,000 BPD and by addition of pumping facilities may be economically increased to 393,000 BPD.

4. Average annual throughputs have been assumed to increase from 200,000 BPD in the first year of operationto 385,600 BPD in the tenth year, the final year considered.

Preparation of the Report

Route reconnaissance was made by automobile and aircraft over the various possibilities, and as a result two principal routes were selected for final consideration. A further check of critical points and alternate sections on these routes was made as needed. Detailed notes of a number of previous investigations over the entire area were also of assistance, as were actual construction cost information on the several existing pipeline systems which parallel some parts of the routes considered.

Pipeline route locations were made with the use of aerial photographs and topographic maps and based upon the reconnaissance notes.

Hydraulic studies of the various routes were made after profiles were developed from the above information. Schematic arrangements of a number of alternative designs and routes were then produced. On the basis of preliminary cost estimates, a number of the alternatives were then eliminated. More exact cost estimates were then compiled for remaining alternates using quotations from manufacturers and other realistic data.

Operating costs then were prepared which further reduced the alternative schemes then deserving further comparison.

Financial requirements have been developed for the alternate systems to determine required income over the period of years from which tariff rates were selected. The rates were then used to project pro forma financial data for the future years of operation to test their adequacy.

Volume IA is generally arranged to begin with the premises, followed by a design discussion, and concluded with the financial data derived therefrom. Volume II defines the system recommended in specification form suitable for incorporation with later detailed drawings and final bills of materials into complete plans and specifications of the system.

DUTTON-WILLIAMS BROTHERS LIMITED

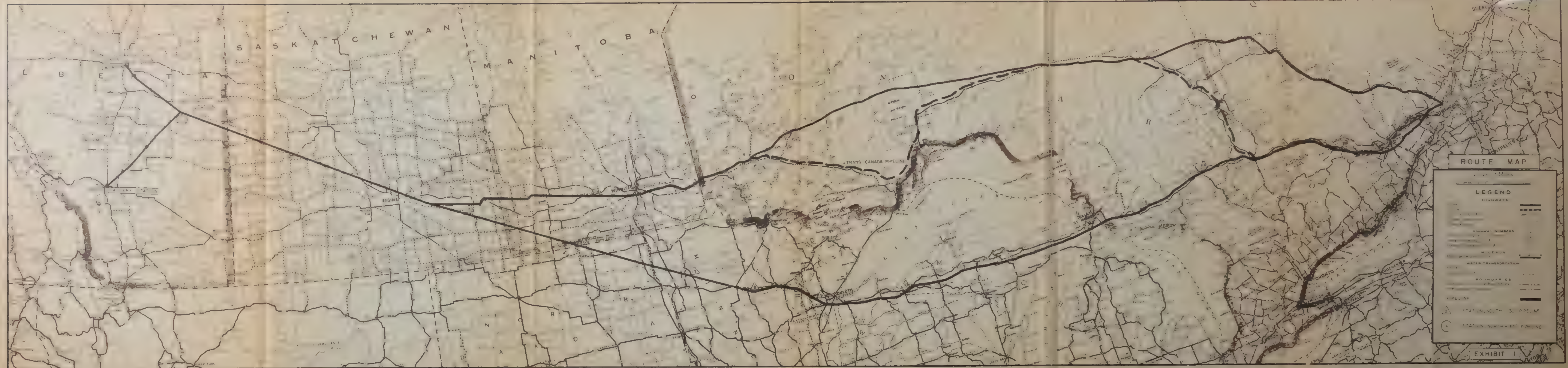
ENGINEERS - CONSTRUCTORS

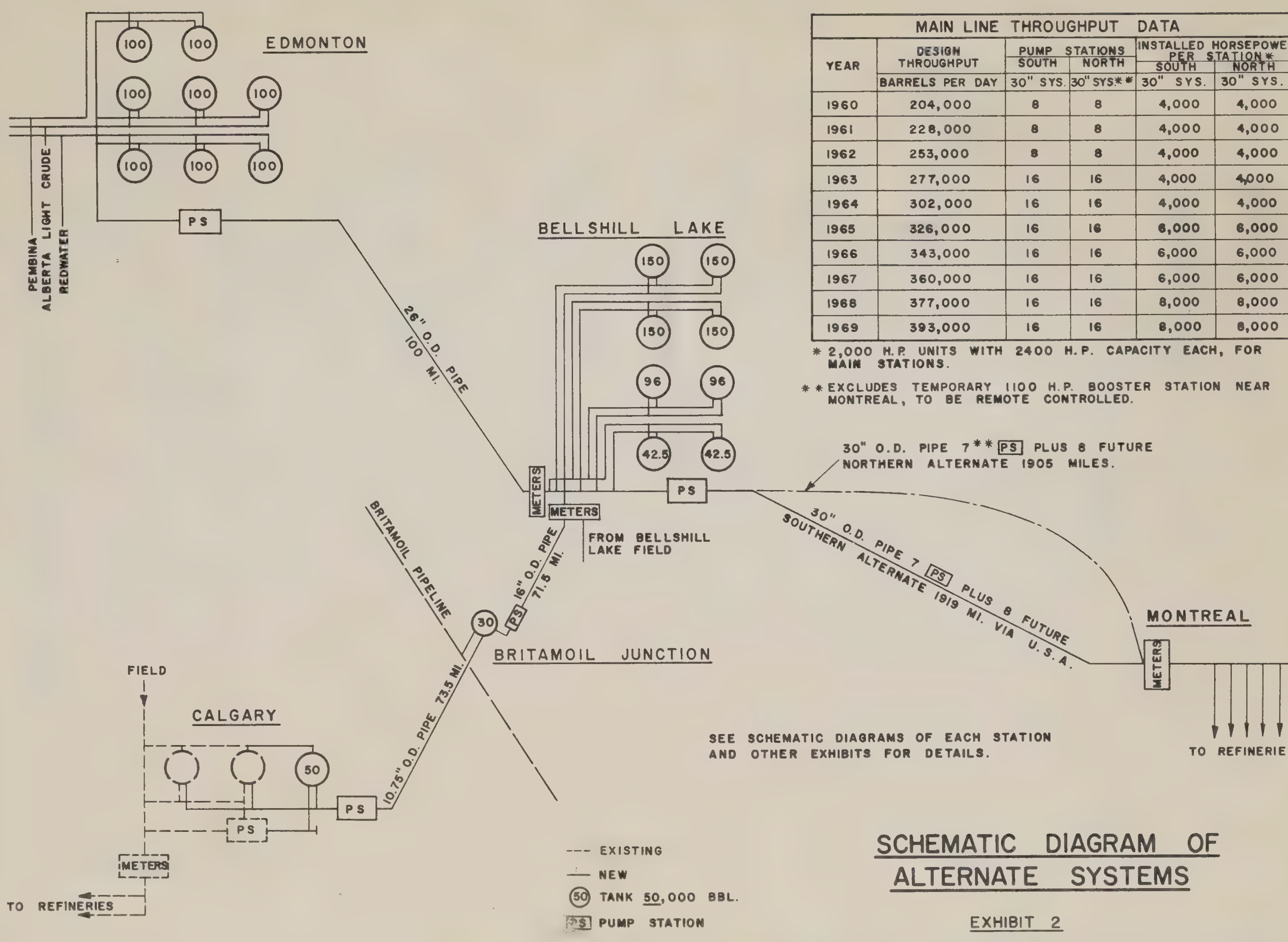
It is hoped that the report contains design decisions and sufficient definition of the system to facilitate the planning of this project.

Respectfully submitted,

DUTTON-WILLIAMS BROTHERS

R. G. Murray, Jr.
Executive Vice-President


ROUTE MAP
LEGEND
HIGHWAYS
WATER TRANSPORTATION
EXHIBIT I
SASKATCHEWAN
MANITOBA
TRANS CANADA PIPELINE
REGINA
DULUTH



MAIN LINE THROUGHPUT DATA

YEAR	DESIGN THROUGHPUT	PUMP STATIONS SOUTH	PUMP STATIONS NORTH	INSTALLED HORSEPOWER PER STATION* SOUTH	INSTALLED HORSEPOWER PER STATION* NORTH
	BARRELS PER DAY	30" SYS.	30" SYS**	30" SYS.	30" SYS.
1960	204,000	8	8	4,000	4,000
1961	228,000	8	8	4,000	4,000
1962	253,000	8	8	4,000	4,000
1963	277,000	16	16	4,000	4,000
1964	302,000	16	16	4,000	4,000
1965	326,000	16	16	6,000	6,000
1966	343,000	16	16	6,000	6,000
1967	360,000	16	16	6,000	6,000
1968	377,000	16	16	8,000	8,000
1969	393,000	16	16	8,000	8,000

* 2,000 H.P. UNITS WITH 2400 H.P. CAPACITY EACH, FOR MAIN STATIONS.

** EXCLUDES TEMPORARY 1100 H.P. BOOSTER STATION NEAR MONTREAL, TO BE REMOTE CONTROLLED.

SEE SCHEMATIC DIAGRAMS OF EACH STATION AND OTHER EXHIBITS FOR DETAILS.

SCHEMATIC DIAGRAM OF ALTERNATE SYSTEMS

EXHIBIT 2

VOLUME I

ENGINEERING AND ECONOMIC STUDIES

Table of Contents

Table of Contents (Continued)

DESIGN EXHIBITS

CHAPTER I

ENGINEERING STUDIES

A. INTRODUCTION

1. FUNCTION OF THE SYSTEM

The purpose of the proposed Alberta-Montreal crude oil pipeline is to provide the most economical transportation for the proven and potential oil reserves in Western Canada to the Montreal refining area. Although evaluations of the crude supply, market outlets and determinations of probable minimum shipments over a ten year period have been prepared by others, the function of the system can be briefly described as follows.

Present outlets for Alberta crude consume less than 50 percent of the rated production capacity. Reserves due to new discoveries are increasing at a rate greater than the potential consumption of present markets. Exploration and drilling operations are slowing due to lack of payout for new discoveries.

Meanwhile, the Montreal area imports a substantial amount of foreign crude at a cost representing about one-third of Canada's trade deficit. A foreign source of such crude is subject to variations in world affairs and upon ocean transportation. This factor may be critical in case of a world or Canadian national emergency.

Present crude oil transportation from Alberta eastward, which might be extended to Montreal, is operating at such capacity that it could not serve the Montreal market in any quantity without a corresponding reduction in its present service to other points.

Montreal is the only marketing area remaining in Canada with sufficient demand to substantially utilize shut-in reserves in Alberta. Export of these reserves to the United States is continuously dependent upon the prevailing import policy of the United States to protect its own producers, and continuously dependent upon prevailing competitive prices of other foreign crudes which may be imported without field proration at the source.

The function of the proposed pipeline system, then, would be to provide a transportation medium of such economic effectiveness that the eastern Canadian market of the Montreal area may be served competitively by Canadian reserves.

2. PURPOSE AND SCOPE OF THE REPORT

This report has been prepared under the instructions of Home Oil Company Limited, representing a group of Alberta producers. The report summarizes results of route reconnaissance and planning studies undertaken to determine an economical crude oil transmission system from Alberta to Montreal.

The purpose of the report is fivefold:

(1) To define alternate systems derived from field engineering and economic studies as appearing most feasible for present and future indicated needs.

(2) To recommend one of the alternate systems as most satisfactory based on the premises supplied.

(3) To supply realistic cost estimates for financial arrangements.

(4) To furnish an estimate of required annual income and tariff rates necessary to support the system.

(5) To present sufficiently definitive engineering and economic aspects to permit construction to proceed with a minimum of delay.

Certain aspects of the feasibility of the system are beyond the scope of this report, and beyond the assignment therefor. These aspects include:

(1) A discussion of the reserves in Alberta or more particularly the adequacy or selection of certain fields or areas in Alberta to satisfy pipeline throughput premises, or the designation of gathering points.

(2) Evaluation of the Montreal area as an outlet for Western crude oil.

(3) Evaluation of the effect of the tariffs derived in this report upon competitive marketing, or upon the economics of production.

It is understood however that the foregoing aspects have been or will concurrently be treated in reports by others.

3. TERMINOLOGY

Some brief reference terms have been utilized to avoid repeating descriptive identifications throughout the report.

Definitions of such terms follow:

Company	the owner of the proposed Alberta-Montreal crude oil pipeline system
Calgary Lateral	the lateral from Calgary to Bellshill Lake, crossing the Britamoil pipeline between the Stettler and Drumheller fields
Britamoil Junction	the junction point between the Britamoil pipeline and Calgary Lateral
Edmonton Lateral	the lateral from Edmonton to Bellshill Lake
Main Line, mainline	the pipeline from Bellshill Lake to Montreal
bbl.	barrel
BPD	barrels per day
MBPD	thousands of barrels per day
MBPYr	thousands of barrels per year
psi	pounds per square inch
OD	outside diameter
ID	inside diameter
dia.	diameter
wall	wall thickness of pipe
SSU	Saybolt Seconds Universal
API	American Petroleum Institute
ASA	American Standards Association
^{o}F	degrees Fahrenheit

MP	milepost measured from origin of traverse
"	inches
'	feet
HP	hydraulic horsepower
HPo, BHP	operating horsepower or brake horsepower
HPi	installed horsepower
matl	material
const	construction

B. PREMISES OF PIPELINE SYSTEM

1. DISCUSSION OF DEMAND

As previously stated, it is beyond the scope and assignment of this study to develop the demand or supply aspects of crude oil for this system. However, throughput requirements in general were derived as outlined herein.

From the recent study by Walter J. Levy, oil economics consultant, the demand for foreign crude oil and products in the Montreal area for 1960 is estimated to be 282,000 BPD and 32,000 BPD respectively. (See Page 1-12, Levy report.) It has also been estimated that the Alberta-Montreal pipeline could supply replacement of 70 percent of this crude oil market, or 200,000 BPD.

Present Montreal refiners operate on crude stock averaging 30° API gravity (at 60°F), composed principally of Venezuelan and Middle East crudes ranging from 25° API to possibly 35° API. Alberta crudes tentatively selected to serve Montreal have an average gravity of about 35.5° API.

Complete utilization of a lighter charge stock would effect a further deficit in heavy fuel oil supply in the area. This deficit should eventually be mitigated or possibly eliminated by natural gas utilization from the Trans-Canada pipeline. Also, if the trend to higher motor octanes continues, future refinery additions and new installations may require the higher gravity stock afforded by Alberta.

Some of these and other considerations are treated in detail in the Levy and Purvin & Gertz reports. However, the considerations briefly mentioned above substantiate the fact that about 70 percent of the 1960 Montreal demand for crude oil could reasonably be satisfied by Alberta crudes, and a higher percentage thereafter.

The Levy report (Page 1-16) further states that in 1965 crude oil demand in the Montreal area would reach some 396,000 BPD with no products imports required. It is assumed the Alberta-Montreal pipeline could capture 80 percent of this market, or 320,000 BPD, in light of the foregoing discussion and more detailed analysis. The throughput buildup in the pipeline between 200,000 BPD in 1960 and 320,000 BPD in 1965 is assumed as a straight line to obtain annual increments.

After 1965, it is assumed that Canadian crude oil can supply 100 percent of the increase in Montreal requirements at the 1960 to 1965 rate of demand growth. In 1960, a total of 314,000 BPD of crude oil and products demand is projected as previously stated. The 1965 demand is similarly 396,000 BPD -- an increase of 82,000 BPD

in five years. This annual increase of 16,400 BPD has been used to extrapolate the demand requirements in Montreal for Alberta crudes through 1969.

Requirements past 1969 are not estimated and further throughput projection is not attempted herein. Certainly intra-Canadian growth in the prairie provinces, the Toronto, Northern Ontario and Maritime areas, and even the possibility of crude oil export could eventually influence the ultimate pipeline throughput requirements.

Therefore, in order to maintain realistic premises, the engineering and economic studies herein do not consider the throughput buildup after 1969.

In summary, the throughputs in annual increments as herein developed are tabulated below. The daily rates shown would require 365-day continuous pumping, which is impractical in actual operation. Design throughputs, derived later in the report, allow about seven days per year, or two percent of the time, for emergency and routine shutdowns for maintenance and overhaul of the system.

Year	Throughput, BPD*
1960	200,000
1961	224,000
1962	248,000
1963	272,000
1964	296,000
1965	320,000
1966	336,400
1967	352,800
1968	369,200
1969	385,600

* Multiply by 365 to obtain annual rates.

2. DISCUSSION OF SUPPLY

The Levy report (Page 1-7) shows a surplus for 1957 between Alberta's productive capacity and actual production to meet demand, of about 370, 000 BPD (50 percent of capacity). The report further states (Page iii) that by 1965 the gap is likely to be some 500, 000 BPD. Discoveries northwest of Edmonton are also to be considered. The work of other consultants can also be used to fully substantiate the Alberta supply as more than adequate to meet Montreal demands without jeopardizing present markets for Alberta crude.

A presently insignificant consideration is that the route of the proposed pipeline intersects the Westspur pipeline in Eastern Saskatchewan. South Saskatchewan crudes now have marketing outlets but new discoveries in the future could utilize the proposed system if other marketing facilities were operating above economic capacity.

It is definitely not the function of the Alberta-Montreal pipeline to compete with other pipeline systems presently installed or compete in the markets served thereby. But the proposed pipeline could in the future relieve existing facilities of excessive capacities at uneconomical operation, providing the economic capacity of the proposed system is sufficient.

Extensive study by others has furnished for this report a distribution of sources of the throughput from the various Alberta fields. Heavier Alberta crudes, below about 38^{o} API, were favored for initial operations to correlate with the demand of present Montreal refineries. Economics of gathering was also considered in these assumptions in the interest of effectiveness of the overall system.

After consideration of these two points, the deficit between present allowable production and productive capacity was noted for the fields to determine surplus capacity geographically. Laterals from Edmonton and Calgary to a common point at Bellshill Lake appeared to present a feasible gathering system. The Calgary Lateral would receive the major portion of its stream about midway to Bellshill Lake, from the present Britamoil pipeline.

It is assumed that the Britamoil pipeline would deliver volumes from fields including Drumheller, West Drumheller, Wayne, Fenn-Big Valley, Stettler and some smaller fields. The Calgary Lateral stream would be augmented to a relatively small degree by flow from Calgary. The throughput from Calgary would represent surplus over Calgary requirements, and originate from Harmattan, Harmattan East, Westward Ho, Sundre and possibly other fields, delivered to Calgary via the Cremona pipeline. A small volume would be injected directly at Bellshill Lake from Bellshill Lake Field

which contains a preferred heavy gravity crude.

Deliveries to Edmonton have been based on the incremental production from these major fields: Pembina, Leduc, Redwater, Acheson, and Golden Spike. The Texaco stream initially excluded from consideration because of high gravity, would probably be added to shipments as refinery capacity permits. The Peace River steam has been considered as being devoted to the Trans-Mountain pipeline. Pembina has been used to compensate for the exclusion of these two streams.

The Pembina stream as used in this report would include production from new fields mainly north and northwest of Edmonton such as Swan Hills, Red Earth, etc. Such new and future discoveries would reduce the balancing demand on the Pembina field.

The term, Alberta Light, has been used to denote Leduc, Acheson, Golden Spike and other light crude streams flowing to Edmonton. It is assumed that three crudes would be batched out of Edmonton - Pembina (including Swan Hills), Redwater and Alberta Light. Based on prorated production capacity figures, these crudes would be batched in the following proportions:

Pembina	39.5%
Redwater	37.5%
Alberta Light	23.0%

All streams from Calgary and Britamoil will be comingled to Bellshill Lake.

A Throughput Development Chart, Exhibit 3, appears on the following page. The chart shows the amount of throughput from each source for each of the ten years considered. This chart represents the basis for ensuing hydraulic calculations.

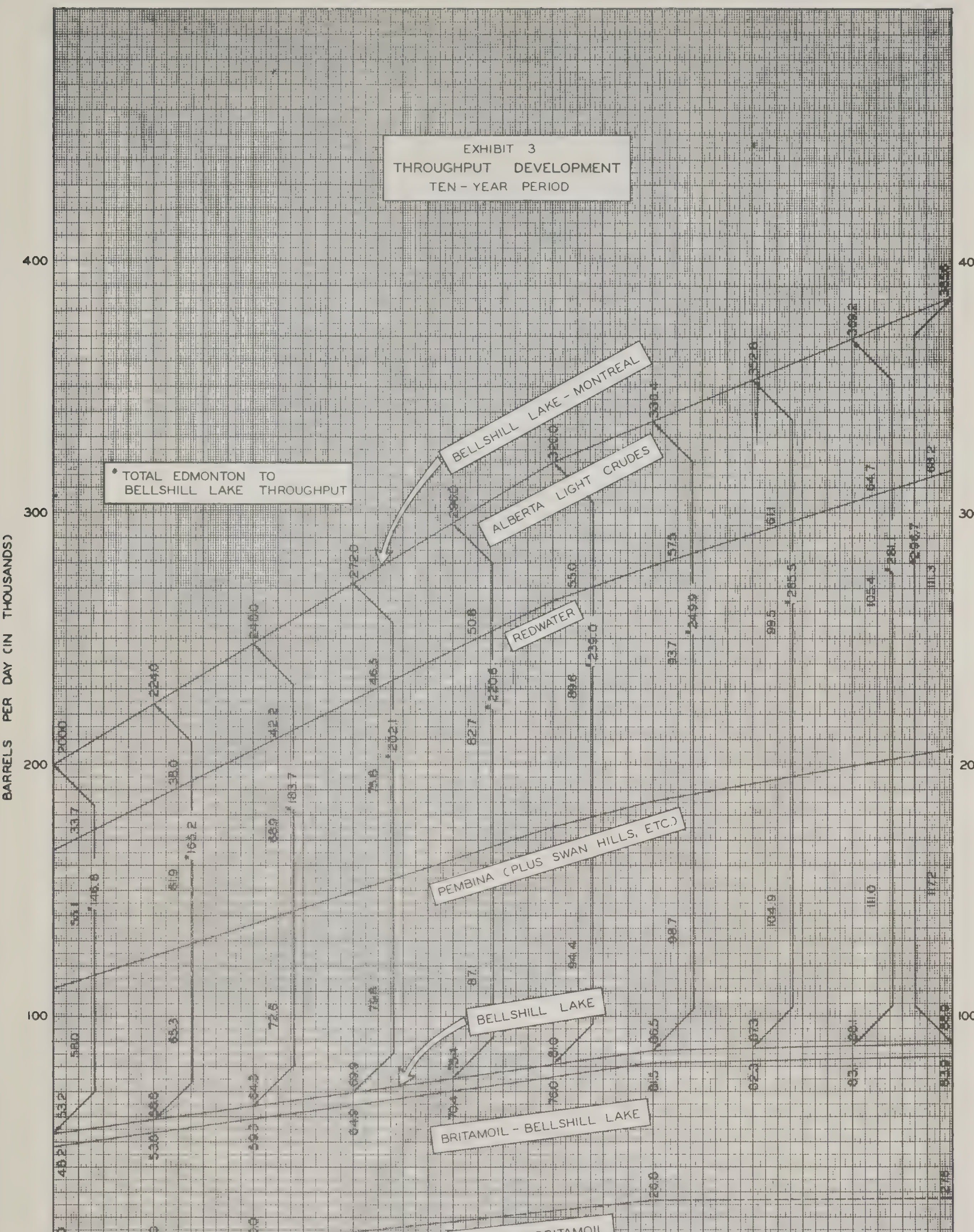


EXHIBIT 3
THROUGHPUT DEVELOPMENT
TEN - YEAR PERIOD
* TOTAL EDMONTON TO BELLSHILL LAKE THROUGHPUT
BELLSHILL LAKE - MONTREAL
ALBERTA LIGHT CRUDES
REDWATER
PEMBINA (PLUS SWAN HILLS, ETC.)
BELLSHILL LAKE
BRITAMOIL - BELLSHILL LAKE
CALGARY - BRITAMOIL
BARRELS PER DAY (IN THOUSANDS)
YEAR
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969

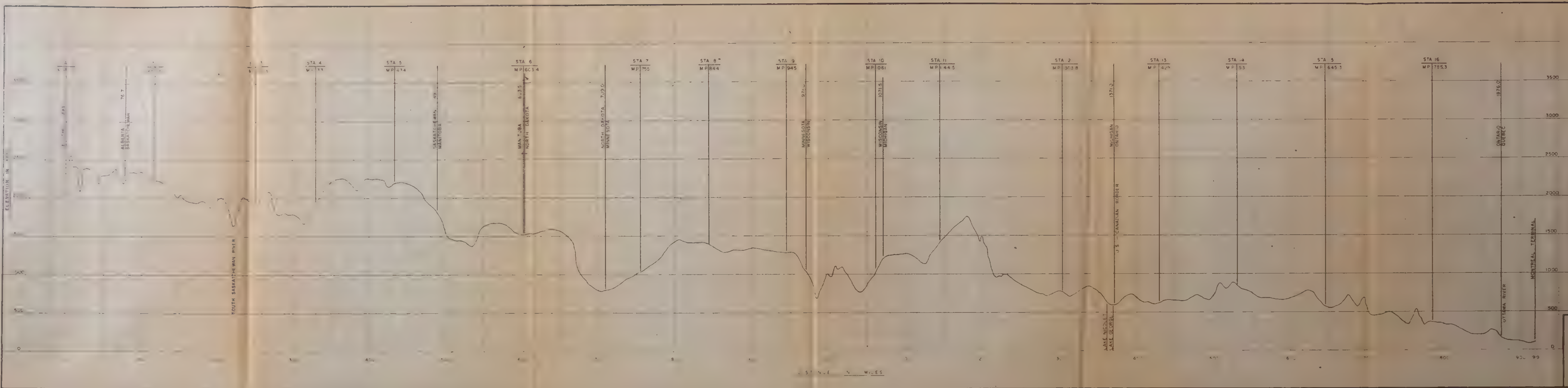
EXHIBIT 3

3. GATHERING AND TERMINAL FACILITIES

It is assumed that all throughput will enter the system through existing pipelines except for the minor amounts (5,000 BPD) injected directly at Bellshill Lake. The Calgary stream enters through the Cremona pipeline, the Britamoil stream through the Britamoil pipeline, and the Edmonton stream through three existing lines via short connecting lines. Therefore, no significant gathering facilities need be installed, except for the respective pump stations and tankage.

Major tank farms are required at Edmonton and Bellshill Lake since three grades of crude oil are batched in and out of Edmonton, and four grades in and out of Bellshill Lake. Small tankage is required at Calgary, and at Britamoil Junction to comingle the incoming streams for further transmission. Calculation of tankage requirements is shown under Section E, Description of Proposed Facilities.

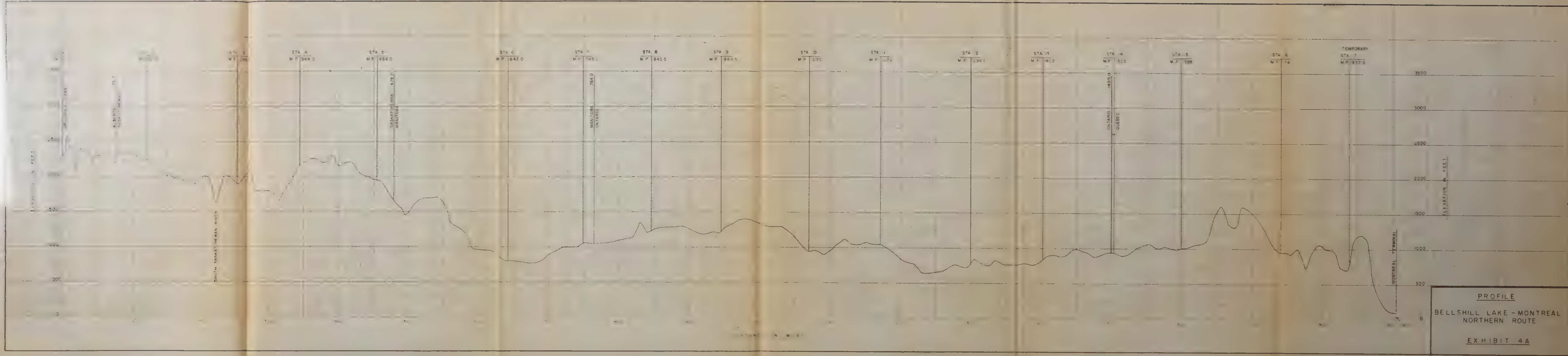
Batching of four grades of crude oil allows selective receipt of any grade by each of the Montreal refineries. A manifold would be located at a central point between refineries, with a transfer pipeline of about two miles average length laid to each refinery. Custody transfer would occur at the manifold by use of positive displacement meters.

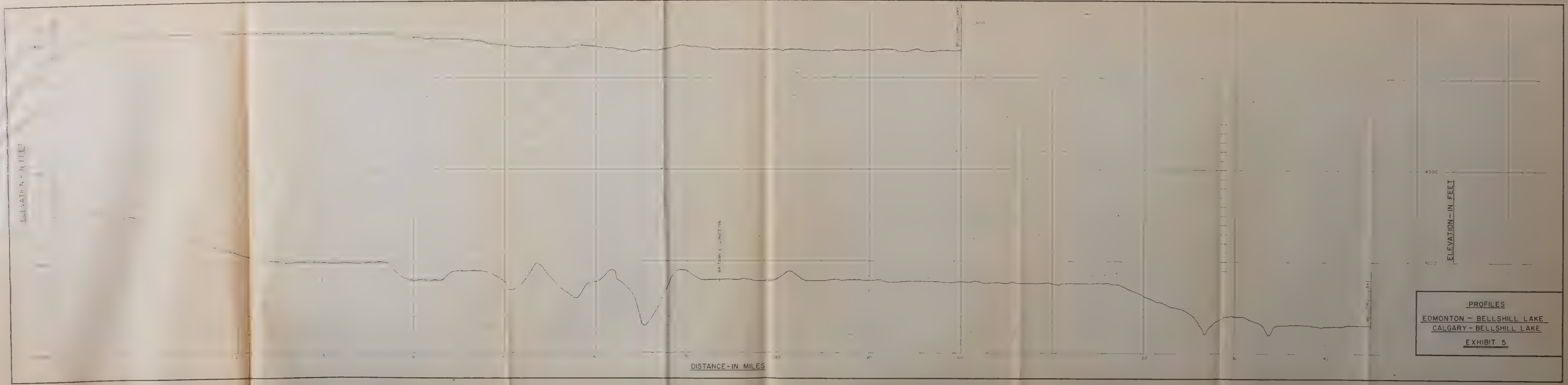


PROFILE

BELLSHILL LAKE – MONTREAL
SOUTHERN ROUTE

EXHIBIT 4


STA 4
M.P. 344.0
STA 5
M.P. 454.0
STA 6
M.P. 642.0
STA 8
M.P. 845.5
STA 9
M.P. 944.5
TEMPORARY
SOUTH SASKATCHEWAN RIVER
SASKATCHEWAN
MANITOBA
MANITOBA
ONTARIO
ONTARIO
QUEBEC
MONTREAL TERMINAL
3500
3000
2500
2000
1500
1000
500
0
ELEVATION IN FEET
PROFILE
BELLSHILL LAKE - MONTREAL
NORTHERN ROUTE
EXHIBIT 4A



ELEVATION-IN FEET
4000
DISTANCE-IN MILES
PROFILES
EDMONTON - BELLSHILL LAKE
CALGARY - BELLSHILL LAKE
EXHIBIT 5

4. SELECTION AND DESCRIPTION OF ROUTE

Since the proposed pipeline serves no intermediate points between Bellshill Lake and Montreal, the most direct route between the two points would in general effect the minimum of cost and resulting tariff. Some deviation is economically warranted to avoid rocky or rough terrain or populated areas where construction costs are excessive. In addition, consideration is given to accessibility of the traverse by road for maintenance or emergency repairs.

After the basic route was selected, the traverse was further defined by aerial and ground reconnaissance and a careful study of large-scale topographic maps. Areas such as the water crossings at Sault Saint Marie were given particular attention at the site to determine an economic routing and realistic cost estimate for construction.

The most economical route derived is shown as the lower solid line on the Route Map, Exhibit A, in the front of the report. This route is termed the Southern Route, and passes partially through the United States. United States passage should not affect throughput expenses, since the oil would travel in bond from border to border without tankage. It is understood no United States transportation tax would be effected as long as no tankage is installed in the States.

An alternate, or Northern Route, is also shown on the route Map as the upper solid line, and does not cross the international border. This route is approximately 14 miles shorter than the Southern Route, but crosses an area of about 800 miles of rock and muskeg terrain. This stretch is sparsely populated and would entail excessive construction and maintenance costs. Alternate costs and required tariffs are presented in Chapter II for both routes.

The profiles of the two lateral lines terminating at Bellshill Lake are shown on Exhibit 5 following this section. The Calgary Lateral traverses relatively flat farm land from its origin near Calgary to the Britamoil Junction at Milepost 73.5. The Red Deer River is crossed at Milepost 65. At this point the river valley is approximately 5 miles wide and 600 feet deep. Some heavy grading will be required at the edges of the valley.

From Britamoil Junction to Bellshill Lake at Milepost 145 the route crosses flat farm and grazing land with some light brush. Small ponds and sloughs are numerous in this area but should present no construction difficulty.

The Edmonton Lateral passes through farm and grazing land with some small sloughs and light brush from its origin to about Milepost 50. From Milepost 50 the route is relatively flat, mostly farm land with a small amount of brush. The Edmonton Lateral terminates at Bellshill Lake at Milepost 100.

Exhibit 4 shows the profile of the Main Line for the Southern Route. The Alberta portion of the Main Line traverses flat farm and grazing land with light brush and some small ponds and sloughs. The Alberta border is crossed at Milepost 76.7.

The Saskatchewan portion of the Main Line crosses farm land with occasional ponds and sloughs. The South Saskatchewan River is crossed near Milepost 215 and this crossing is considered a major underwater crossing. The route also crosses numerous small streams and creeks, none of which will present any construction difficulties. The Saskatchewan-Manitoba border is crossed at Milepost 490.

The route crosses the southwest corner of the Province of Manitoba, an area of mostly farm land with a small amount of brush. No construction difficulties are expected in crossing the small streams in this area. The Manitoba-North Dakota border is crossed at Milepost 603.5.

The North Dakota portion of the Main Line crosses flat farm land with very little tree cover and with occasional small creeks. This section ends at the Red River crossing at Milepost 709 which is the North Dakota-Minnesota border. This river crossing is not considered a major river crossing.

The Minnesota portion of the route extends from Milepost 709 to Milepost 971. The western part of this section is flat farm land, the remaining portion is swampy with numerous lakes and streams.

The Wisconsin section extends to Milepost 1071.5 and crosses an area with some farm land, some tree cover and numerous streams flowing north into Lake Superior.

The Michigan section, from Milepost 1071.5 to Milepost 1370 crosses a small amount of farm land, the remainder consisting of wooded areas with a great many lakes and swamps. Some solid rock area will be crossed in western Michigan. Lake Nicolet below Sault Ste. Marie is approximately one mile wide and 25 feet deep at the point of crossing. The International Boundary is crossed in Lake George at Milepost 1370. This crossing is approximately one-half mile wide and thirty feet deep.

The Ontario section of the route extends from Milepost 1370 to Milepost 1876.5. Rock will be encountered throughout this section with practically solid rock terrain near and east of Sudbury. Difficult construction is expected between Lake George and Pembroke with most difficulty expected near Sudbury. From Pembroke to the Quebec border near Point Fortune the route traverses farm land with small quantities of brush and swampy areas.

The Quebec part of the route is primarily farm land. This section includes the Ottawa, Mille Iles and Prairie River Crossings. Rock excavation is expected in these river crossings.

The Southern Route terminates near the refinery area of Montreal at Milepost 1919.

Exhibit 4A shows the profile of the Main Line for the Northern Route. This route is the same as the Southern Route to Milepost 390, in Saskatchewan. From Milepost 390 to the Manitoba border at Milepost 479 the route traverses mainly farm land with some sloughs.

The route in Manitoba runs eastward to Milepost 580 through an area of predominantly farm land with innumerable small sloughs. The terrain changes at this point to a stretch of five miles with very choppy, low hills with light tree cover. The country then again becomes farm land with numerous large drainage canals. From Milepost 700 to the Manitoba-Ontario border the terrain is mainly muskeg with scrub timber cover.

The Manitoba-Ontario border at Milepost 764 is the commencement of very rocky terrain. This rock, and some muskeg, extends to Vermilion Bay at Milepost 850. At Kenora, in this section, the Winnipeg River crossing will be in solid rock. The next 415 miles from Vermilion Bay to Ameson at Milepost 1265 is interspersed rock and muskeg with scattered timber cover. The only access to any of this stretch is via the Canadian National Railways main trans-continental line. Ameson to the Quebec border at Milepost 1499 is generally the same type of terrain and includes another 69 miles of route serviced only by railroad.

The route in Quebec from the border to Mont Laurier near Milepost 1765 is basically the same terrain as previously traversed in Ontario, rock and muskeg. The Gatineau River crossing will be in solid rock. The route from Mont Laurier into Montreal is along several river valleys, through farm land. On the highlands from about Milepost 1780 to 1885 the terrain does include some rock and timber. The final leg from Milepost 1885 into Montreal passes through dense, small farms, a heavy industrial area, and crosses the Riviere Des Prairies. The termination is Milepost 1905.

C. DESIGN PREMISES

1. CLIMATIC CONDITIONS

Climatic conditions along the route affect the system in many ways--in design, construction, and maintenance. A careful analysis is particularly important for this pipeline system, since the fluid to be pumped bears a marked increase in viscosity with decreasing temperatures. Climatic conditions affect not only the hydraulic throughput of the line, but also affect the selection and preparation of equipment, and the periods of construction and maintenance.

The chart on the following page, Exhibit 6, presents climatic data for Regina as obtained from the Department of Transport. The succeeding chart, Exhibit 7, shows mean annual temperature isotherms across Canada. Exhibit 7 illustrates that the mean temperature is approximately the same (35^{o} F) across the traverse, with but slightly warmer conditions (40^{o} F) on the eastern end. A comparison of hythergraphs showing monthly precipitation and temperature for various cities along the route determines that Regina represents average weather conditions.

Regina, as shown by Exhibit 6, has an extreme range of temperatures, varying from an average daily high temperature of 79^{o} F in July to an average daily low temperature of -11^{o} F in January -- with recorded extremes of 107^{o} F and -56^{o} F.

Average temperatures are below freezing from November through March, effecting considerable handicap and additional expense for outside construction work during this period. Design must be adequate for this period to protect liquid cooled equipment, and provide sufficient heat for process and personnel requirements.

Average annual snowfall amounts to only 29 inches, which is a consideration in the design of roof loads for buildings. Total precipitation for the year averages only 15 inches, indicating a relatively dry climate and ease of pipeline maintenance. The hythergraph for Kapuskasing, Ontario, which lies near the Northern Route, shows an annual rainfall of about 28 inches but very similar temperatures to Regina.

Temperatures below ground are important in pipeline hydraulic calculations, since temperature affects viscosity which in turn affects the pressure required to effect a given flow, and the resulting horsepower required. Above ground temperatures naturally affect underground temperatures, but the extent is dependent upon not only the depth considered but also upon the cohesiveness, void ratio, and percolation rate of the soil.

REGINA, SASK.—50°26′N. 104°39′W. 1,884 FEET ABOVE SEA

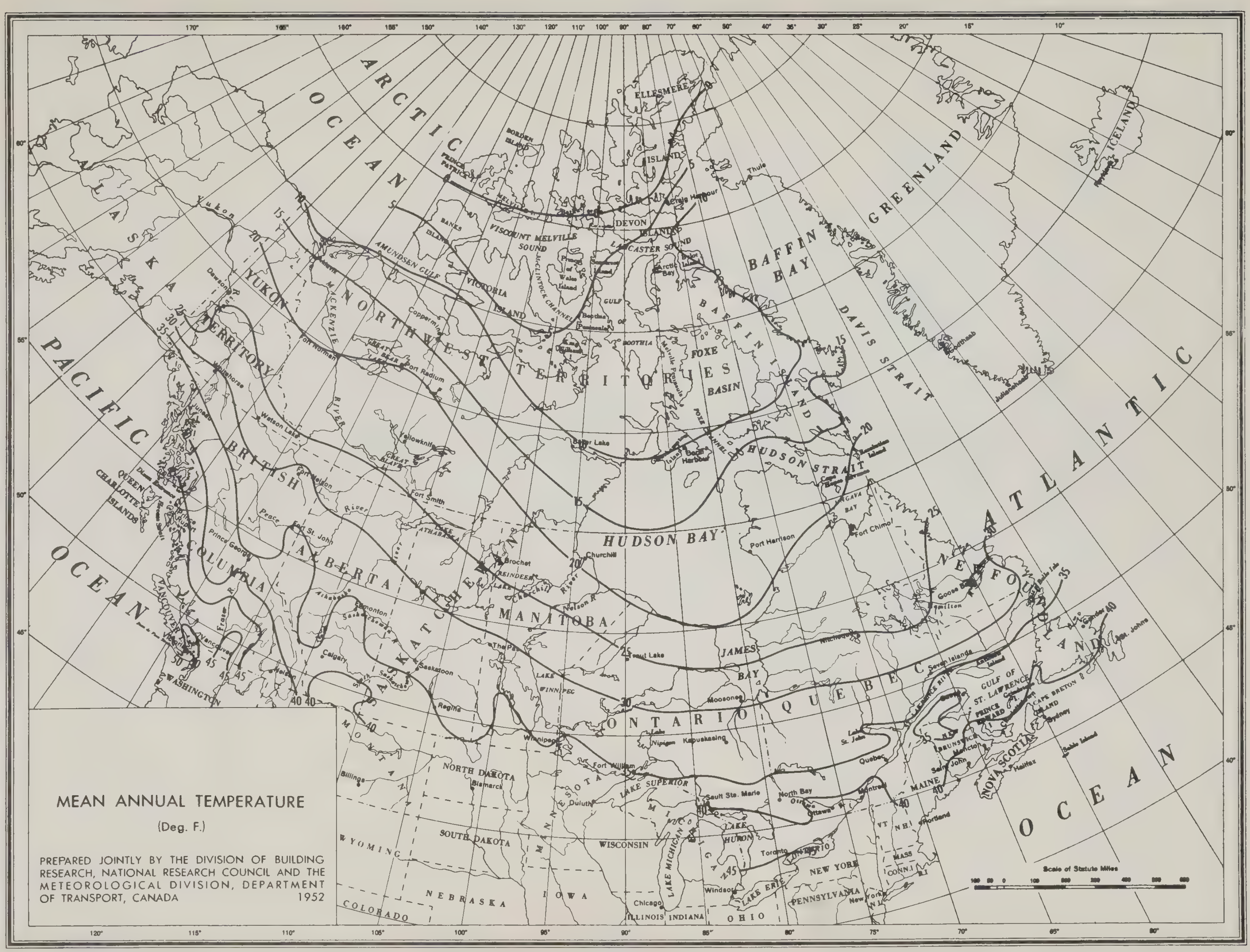
	Temperature							Precipitation				
	Average Daily			Extremes				Rain		Snow		Total Precipitation (water)
				Average		Record						
	Mean	High	Low	High	Low	High	Low	Inches	Days	Inches	Days	
	°F.	°F.	°F.	°F.	°F.	°F.	°F.	No.	No.	No.	No.	in.
Jan.	0·7	9·5	−10·9	36	−38	48	−54	0·04	1	4·7	8	0·51
Feb.	2·0	12·6	−8·6	37	−35	53	−56	0·01	[1]	3·4	13	0·35
Mar.	16·5	26·9	6·1	47	−22	76	−44	0·13	1	5·4	9	0·67
Apr.	37·8	49·7	26·0	73	5	89	−20	0·44	5	3·0	3	0·74
May	51·0	64·8	37·1	85	20	99	7	1·78	8	0·6	1	1·84
June	60·2	73·2	47·2	90	32	102	23	3·24	12	0·1	[1]	3·25
July	64·8	78·9	50·8	93	38	107	28	2·38	11	Nil	Nil	2·38
Aug.	62·2	76·9	47·6	92	34	104	23	1·76	9	Nil	Nil	1·76
Sept.	51·4	64·9	38·0	85	21	99	9	1·26	6	0·6	[1]	1·32
Oct.	39·4	51·8	27·0	75	8	87	−15	0·63	4	2·3	2	0·86
Nov.	21·3	31·6	11·0	55	−14	73	−47	0·12	1	4·8	9	0·60
Dec.	7·6	16·4	−1·3	41	−29	59	−55	0·03	1	3·9	9	0·42
Year	**34·5**	**46·4**	**22·5**	**96**	**−42**	**107**	**−56**	**11·82**	**59**	**28·8**	**54**	**14·70**

	Heating Factor	Wind					Thunder	Bright Sunshine	Frost[2]	Humidity		
	Day-Degrees Below 65°F.	Most Prevalent		Second Prevalent		Average Speed	Days with	Hours of	Days with	Water-Vapour (parts per 1,000)	Relative	
		Direction	Percentage	Direction	Percentage	Miles per Hour					24-Hour	Noon
	No.						No.	No.	No.		p.c.	p.c.
Jan.	2,037	SE.	24	W.	23	12·0	Nil	108	31	1·0	89	86
Feb.	1,818	SE.	26	W.	19	12·1	Nil	126	28	1·1	91	88
Mar.	1,504	SE.	23	NW.	18	13·2	Nil	163	31	1·9	87	83
Apr.	816	SE.	24	NW.	16	13·9	[1]	216	23	3·7	70	60
May	434	SE.	19	E.	19	14·0	2	252	6	5·3	60	47
June	174	E.	18	SE.	17	13·4	3	244	[1]	7·7	69	57
July	48	W.	18	SE.	18	11·4	5	329	Nil	9·7	68	54
Aug.	92	SE.	21	W.	17	12·3	4	285	Nil	8·6	65	52
Sept.	408	W.	20	SE.	19	12·6	[1]	205	4	6·0	69	56
Oct.	794	SE.	24	W.	23	12·9	Nil	170	17	4·3	70	58
Nov.	1,355	SE.	26	W.	21	13·0	Nil	98	30	2·0	88	83
Dec.	1,779	SE.	27	W.	21	12·1	Nil	98	31	1·3	88	84
Year	**11,259**	**SE.**	**22**	**W.**	**18**	**12·7**	**14**	**2,294**	**201**	**4·4**	**76**	**67**

[1] Less than 5 days in 10 years. [2] Average date of last spring frost June 6; of first fall frost Sept. 10.

REGINA CLIMATIC DATA

EXHIBIT 6



MEAN ANNUAL TEMPERATURE

(Deg. F.)

PREPARED JOINTLY BY THE DIVISION OF BUILDING RESEARCH, NATIONAL RESEARCH COUNCIL AND THE METEOROLOGICAL DIVISION, DEPARTMENT OF TRANSPORT, CANADA 1952

EXHIBIT 7

The seasonal variation of soil temperatures moderates at increasing depths, so that higher minimum temperatures are obtained in a pipeline the deeper it is buried. However, construction costs are somewhat proportional to the depth of ditch, so that an economic balance must be attained. It has been assumed that the proposed system would have 36 inches of cover in soil and 20 inches of cover in rock. Therefore, the average depth of centerline of pipe for the Main Line would be about 52 inches in soil and 36 inches in rock.

Many studies were examined of soil temperatures in areas analogous to the traverse proposed. Exhibit 8 on the following page is believed representative for the traverse. The curve shows the great temperature advantage of burying the pipe from three to four feet deep to the centerline. The advantage decreases with increasing depth.

On the basis of Exhibit 8, the minimum flowing temperature of the crude oil would be about 30° F, and a maximum of 54° F. A conservative average design temperature of 35° F was selected. Thus flow should exceed design throughput most of the year, with the possibility of slightly less than design throughput occurring during the coldest periods.

SOIL TEMPERATURE
AT VARIOUS DEPTHS

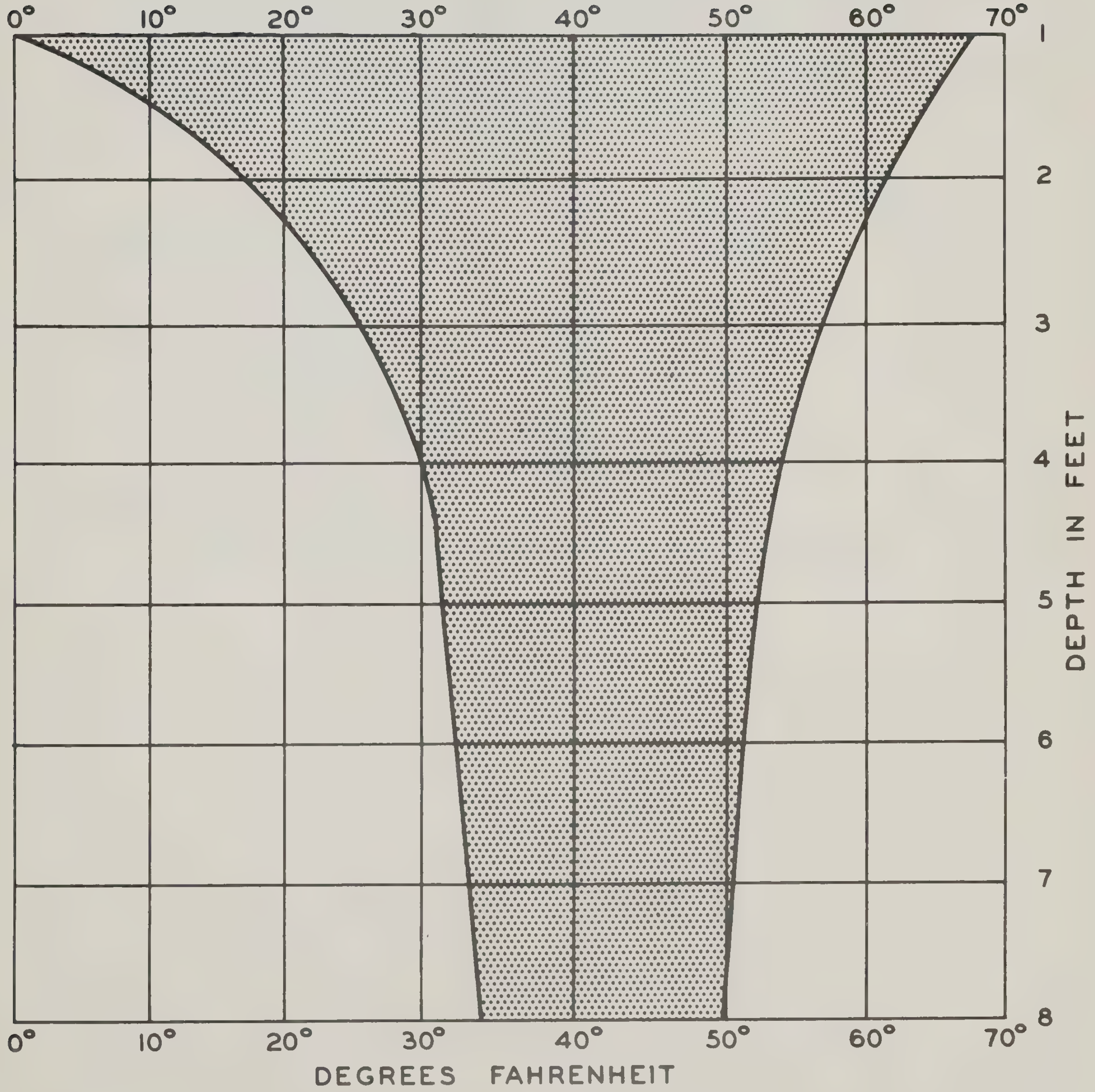


EXHIBIT 8

2. CRUDE OIL CHARACTERISTICS

Physical properties of the crude oil have a marked effect on the hydraulic design of the system. Such properties include viscosity, gravity and pour point. The pour point of all oils considered appears well below the minimum flowing temperature anticipated and thus may be disregarded in this study.

Viscosities and gravities were obtained for the oils from all fields anticipated to contribute to the throughput. Where oils were to be comingled during flow, the respective viscosities were blended appropriately to derive a representative figure. Specific gravities were averaged according to the proportion of each oil comingled. Both viscosities and gravities were converted to the design flowing temperature of 35°F. Results are as follows

Pipeline Sections	At 35°F Gravity API°	At 35°F Viscosity SSU
Edmonton-Bellshill Lake	33.8	118
Calgary-Britamoil Junction	33.3	71
Britamoil Junction - Bellshill Lake	31.4	193
Bellshill Lake - Montreal	33.3	130

These values were used in hydraulic calculations.

3. DESIGN THROUGHPUT

As previously related, throughputs shown on the foregoing Throughput Development Chart represent average daily values for 365 days per year. Since some time must reasonably be reserved for shut-down time to accommodate emergency repairs and maintenance, throughput must be increased the remainder of the time to produce the average daily figures. It is assumed that the pipeline will operate 98 percent of the time, allowing about seven days per year for shut-downs. Therefore, average throughput on an annual basis has been divided by 98 percent to result in the design throughputs shown below.

	Throughput, BPD, for Pipeline Section			
Year	Calgary - Britamoil Jct.	Britamoil Jct. - Bellshill Lake	Edmonton - Bellshill Lake	*Bellshill Lake - Montreal
1960	8, 160	49, 200	149, 700	204, 000
1961	9, 180	54, 900	168, 500	228, 000
1962	10, 200	60, 500	187, 400	253, 000
1963	14, 500	66, 200	206, 100	277, 000
1964	18, 800	71, 800	225, 000	302, 000
1965	23, 000	77, 500	243, 800	326, 000
1966	27, 400	83, 100	254, 900	343, 000
1967	27, 600	83, 900	270, 800	360, 000
1968	27, 900	84, 800	286, 700	377, 000
1969	28, 200	85, 600	302, 600	393, 000

*Includes 5, 100 BPD injected at Bellshill Lake.

D. DESIGN CALCULATIONS

1. FLOW FORMULAS

The basic Fanning Formula was used to calculate pipeline flow data. This formula is expressed as:

$$H_1 - H_2 = \frac{80.54CLQ^2}{d^5}, \text{ where}$$

H_1 = upstream pressure, in feet

H_2 = downstream pressure, in feet

C = friction coefficient

L = length of pipeline section, in miles

Q = throughput, in barrels per hour

d = inside diameter of pipe, in inches

H may be expressed in psi by multiplying it by the specific gravity of liquid and dividing by 2.307. Q may of course be expressed in BPD by adjusting the formula.

C, the friction coefficient, depends on the roughness of the pipe internally and the dimensionless Reynolds number. The Reynolds number may be expressed as:

$$N_R = \frac{22.12Q}{d\ n}$$

where n is the kinematic viscosity of the flowing fluid in stokes. If the Reynolds number is less than about 2,000, flow is laminar, and

$$C = \frac{64}{N_R}$$

If the Reynolds number is between 2,000 and 2,500, flow is in the critical range between streamline and turbulent states, and C is difficult to accurately predict. If N_R exceeds 2,500, as in all cases in this study, flow is turbulent. For turbulent flow, C can be expressed with reasonable approximation by one of a number of

formulas based on empirical data. For this study, the various C values were selected from large charts empirically derived, for purposes of accuracy. Values ranged from C = 0.0211 for a Q of 17,000 BPH and d of 29.125" to C = 0.0344 for a Q of 400 BPH and d = 10.25".

From the above formulae, the pressure loss per mile of pipeline for various throughputs and pipe diameters was plotted to aid in further calculations. The more pertinent of the resulting charts, Exhibit 9 through Exhibit 12, follow. Alternate pipe sizes were selected for each pipeline section and economically compared, with allowance for throughput growth and some flexibility between laterals. Pipe diameters of 10-3/4" OD, 16" OD, and 26" OD were selected for the laterals from Calgary, Britamoil Junction and Edmonton respectively.

Diameters of 26", 30" and 34" were initially considered for the Main Line, but the 26" size was considered comparatively uneconomical after the second year throughput of 228,000 BPD. Therefore, detailed analyses were made for 30" and 34" sizes. Any intermediate size could be rolled on special order.

In detailed analysis, the 34" diameter proved less economical than the 30" for the ten-year throughputs considered herein. Thus only the 30" alternates are presented in this report.

FRICTION LOSS CURVE

CALGARY — BRITAMOIL JUNCTION

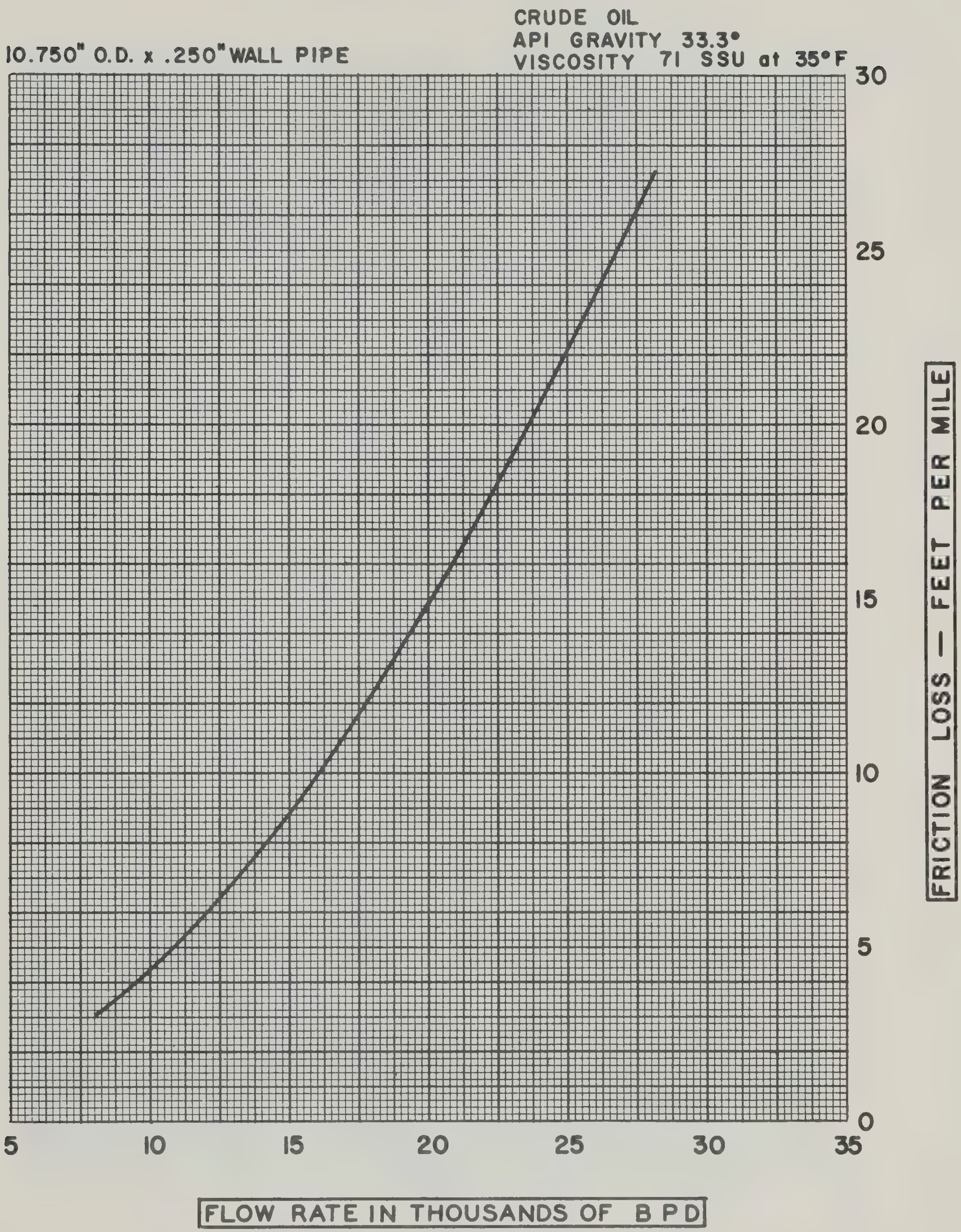


EXHIBIT 9

FRICTION LOSS CURVE

BRITAMOIL JCT.–BELLSHILL LAKE

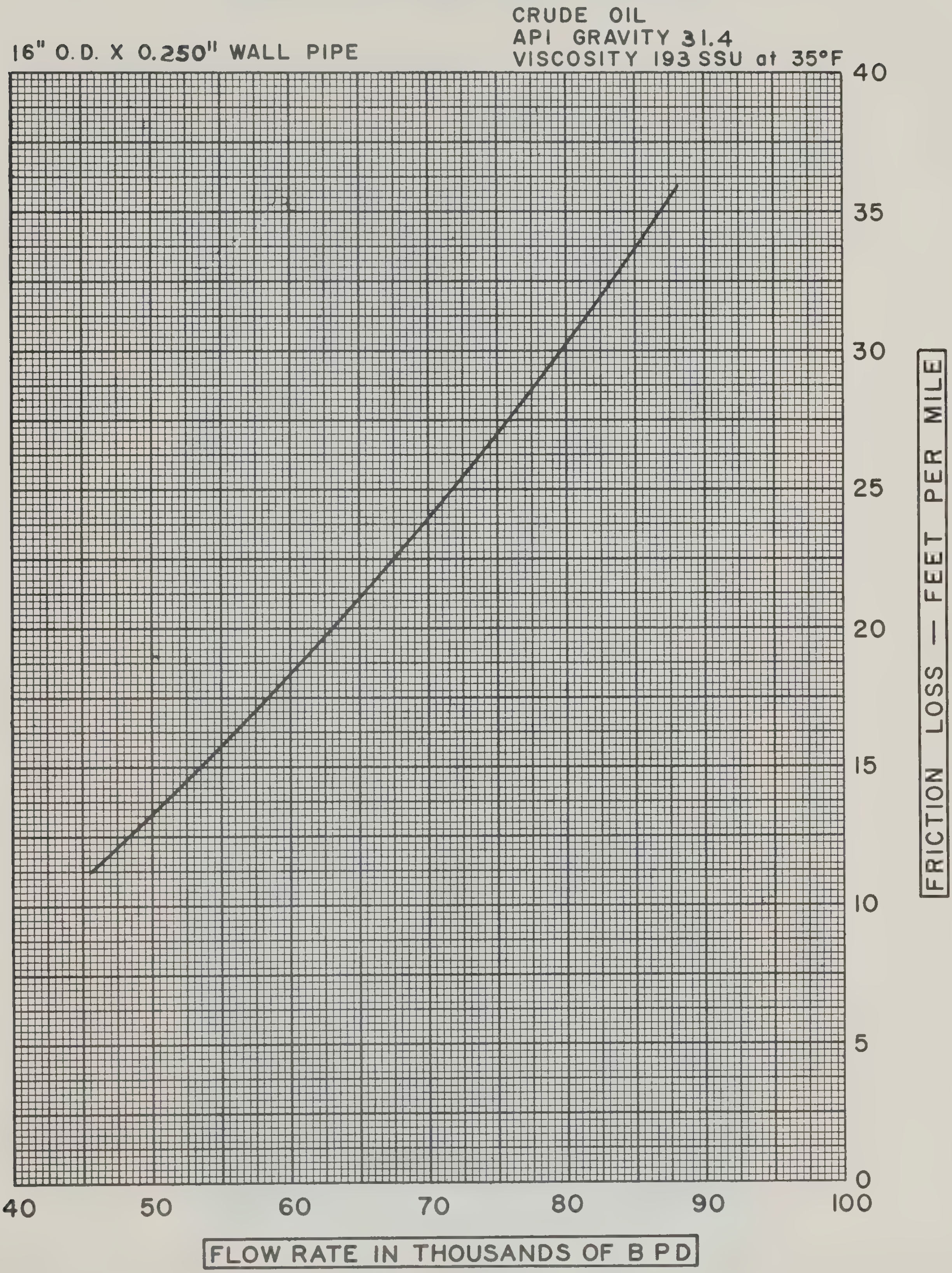


EXHIBIT 10

FRICTION LOSS CURVE

EDMONTON-BELLSHILL LAKE

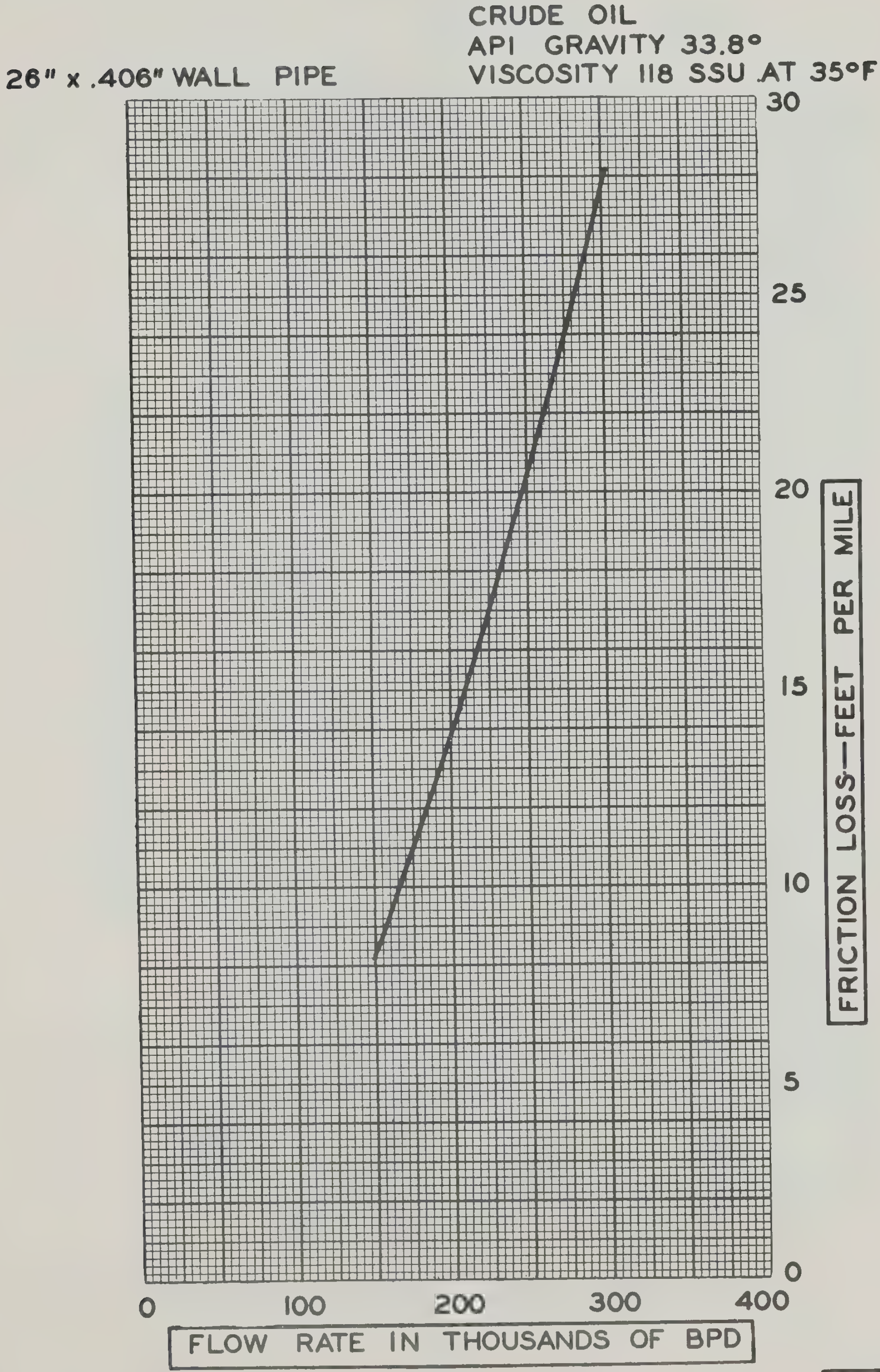


EXHIBIT 11

FRICTION LOSS CURVE
BELLSHILL LAKE – MONTREAL

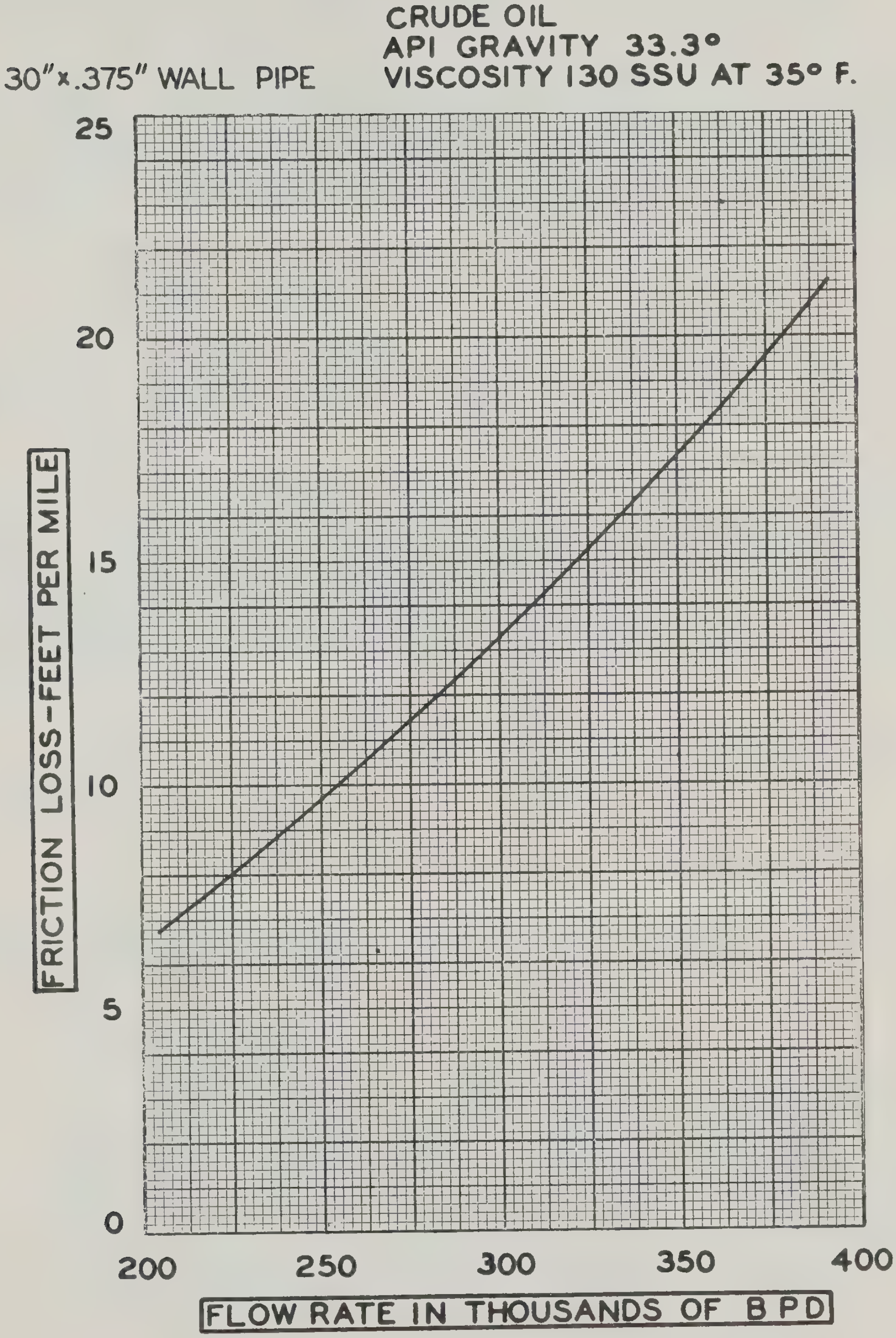


EXHIBIT 12

2. SYSTEM DESIGN

The economic optimum diameter for a crude oil transmission line of given throughput depends on many variables -- such as line length, oil properties, traverse profile, pump station location, operating pressure, allowable pipe stress.

As a rule-of-thumb, however, the friction loss per mile is a reasonable basis for preliminary diameter selection. For a crude oil of the properties corresponding to this study, the economic optimum condition may be very generally expressed by the rule-of-thumb formula:

$$P/L = 13 - \frac{D}{4}$$

where P/L is the pressure drop in psi per mile, and D is the OD of the pipe.

Friction loss design values lower than optimum values usually produce much more economic results than values correspondingly higher. Therefore, for systems expecting throughput growth, it is desirable that friction loss values for initial years of operation be considerably below optimum values. These premises have been developed from detailed engineering and economic studies comparing alternate systems.

A rule-of-thumb for economic optimum working pressure may be expressed as

$$P = 1250 - 15D$$

where P is maximum working pressure in psi, which occurs at pump station discharge when the traverse is fairly level.

a. Pipe Specifications

For large-diameter long-distance transmission lines significant savings result by designing and operating the system at the maximum allowable working stress of the pipe. This is of course true since steel that is not used to its safe capacity represents wasted investment. On this project, each thirty-second of an inch of pipe wall thickness costs approximately $15, 000, 000.

In designing this system wherein the smallest diameter selected is 10-3/4" OD, a minimum wall thickness of 0.250" is recommended. This limit is empirically established in the interests of overall economy, as lesser thicknesses are

subject to considerable damage in handling pipe and complications in welding. Hidden handling damage or weld defects may result in a costly maintenance program and loss of product due to leaks, years after installation.

Four grades of pipe are commonly used for pipelines in accordance with API Standards 5L and 5LX, for line pipe and high-test line pipe respectively. These grades are Grades B, X-42, X-46 and X-52. They vary in chemical properties and yield strength. Minimum yield strenghs according to code are: Grade B, 35,000 psi; X-42, 42,000 psi; X-46, 46,000 psi; and X-52, 52,000 psi.

Thus X-52 pipe is 49 percent stronger than Grade B; and it costs only a few percent more. X-52 pipe, however, is more brittle, and more difficult to satisfactorily weld in cold weather. Where extra strength is not essential, Grade B is preferred for its ductility. This is particularly true for crossings of swift rivers in sandy soil subject to erosion and possible pipe movement.

Maximum allowable working pressures for pipe used in cross-country oil pipelines are established by the ASA Code B 31.1, Section 3. Although it is not mandatory to follow this code in the area traversed, it has been used as representing good pipeline practice. The code modifies Barlow's formula to:

$$t = \frac{PD}{2S} + C$$

where t = design thickness of the pipe wall, in inches
P = maximum working pressure, in psi
D = OD of pipe, in inches
and C = corrosion allowance, in inches

The design thickness, t, must compensate for the manufacturer's tolerance--minus 12.5 percent by API Code. For seamless or electric-resistance-welded pipe, S equals 85 percent of the minimum yield strength. Although the pipe is to be adequately protected from corrosion, a corrosion allowance of 0.05 inches is used as good practice to compensate for minor defects incurred in manufacturing, handling and occasioned by holidays (weak spots) in the protective coating. Therefore, the code formula becomes:

$$t = \frac{PD}{(.875)\,2\,(.85S)} + .05, \text{ or } t = \frac{PD}{2 \times .744S} + .05$$

This expression relates that the pipe may be stressed to about 74.4 percent of yield, less corrosion allowance. For pipe sizes and thicknesses considered in this study, pipe may be stressed to roughly 64 percent of yield if the corrosion allowance of 0. 05 inch is deducted.

Allowable working pressures based on the code formula and a corrosion allowance of .05 inch, in the range of sizes considered, are tabulated below:

Pipe OD	Grade	Wall	Allowable Working Pressure
10-3/4"	B	0.250"	934 psi
16	X-46	0.250"	825
	X-52	0.250"	932
26	X-52	0.438"	1132
		0.406"	1037
		0.375"	945
		0.344"	853
		0.312"	758
30	X-52	0.438"	981
		0.406"	899
		0.375"	819
		0.344"	740
		0.312"	657

All pipe should be ordered double-random length, with ends beveled 30 degrees for welding.

b. Hydraulic Calculations

Pertinent features of hydraulic design have been established, such as oil gravity and viscosity, throughput, pipe wall and diameter, and friction loss. From the profiles, Exhibits 4, 4A and 5, the distance from Calgary to Britamoil Junction is 73.5 miles; from Britamoil Junction to Bellshill Lake, 71.5 miles; from Edmonton to Bellshill Lake, 100.0 miles; and from Bellshill Lake to Montreal, 1,919 miles via the Southern Route, and 1,905 miles via the Northern Route.

The required pressure at the upstream end of each pipeline lateral was calculated by (1) multiplying friction loss per mile for the design throughput by the lateral length in miles,

(2) allowing 37 to 50 psi for terminal losses through piping, valves, equipment and tank filling, and (3) compensating for the difference in elevation between the two ends of the lateral.

The resultant pressure in feet of head may be plotted on the respective profile as a vertical distance above the elevation of the upstream end. The suction pressure converted to feet may be plotted vertically at the terminal end. The slope of the line connecting the two plotted points coincides with the friction loss per unit of distance, and is termed the hydraulic gradient.

The pressure in the pipe at any point along the traverse is equal to the vertical distance between the hydraulic gradient and the ground elevation at the respective point.

Although this axiom relates to elementary hydraulics, it is basic to the frugal design of the main line system, as will be discussed.

Considering first the laterals, the profile presents a problem only near Calgary. A high point exists 5.3 miles from Calgary along the traverse to Britamoil Junction. Gravity flow from this point to the Junction would effect a delivery of about 15,900 BPD, which flow is not required until after 1963. This high point acts as a critical point from which the hydraulic gradient must be projected back to Calgary, until the throughput requirement exceeds 15,900 BPD. At that time, the hydraulic gradient would pass above the critical point, and the terminal elevation would control the required Calgary discharge pressure.

The charts on the following pages, Exhibits 13, 14 and 15, show the discharge pressure and brake horsepower required for each lateral at the flow rates under consideration. Brake (operating) horsepower has been calculated by the formula:

$$BHP = \frac{.0000171 \times BPD \times P}{e}$$

where P = discharge pressure less suction pressure, in psi
e = pump and gear efficiency

Pump and gear efficiency has been assumed as 80 percent. This figure may be slightly high for small pumps at lateral stations, but is conservative overall, since main line units will operate up to 87 percent efficiency. In most cases, installed horsepower in preliminary design is at least 10 percent greater than the required operating horsepower to prevent excessive wear and maintenance of the prime movers.

PRESSURE - FLOW - HORSEPOWER CURVES

CALGARY - BRITAMOIL JCT.

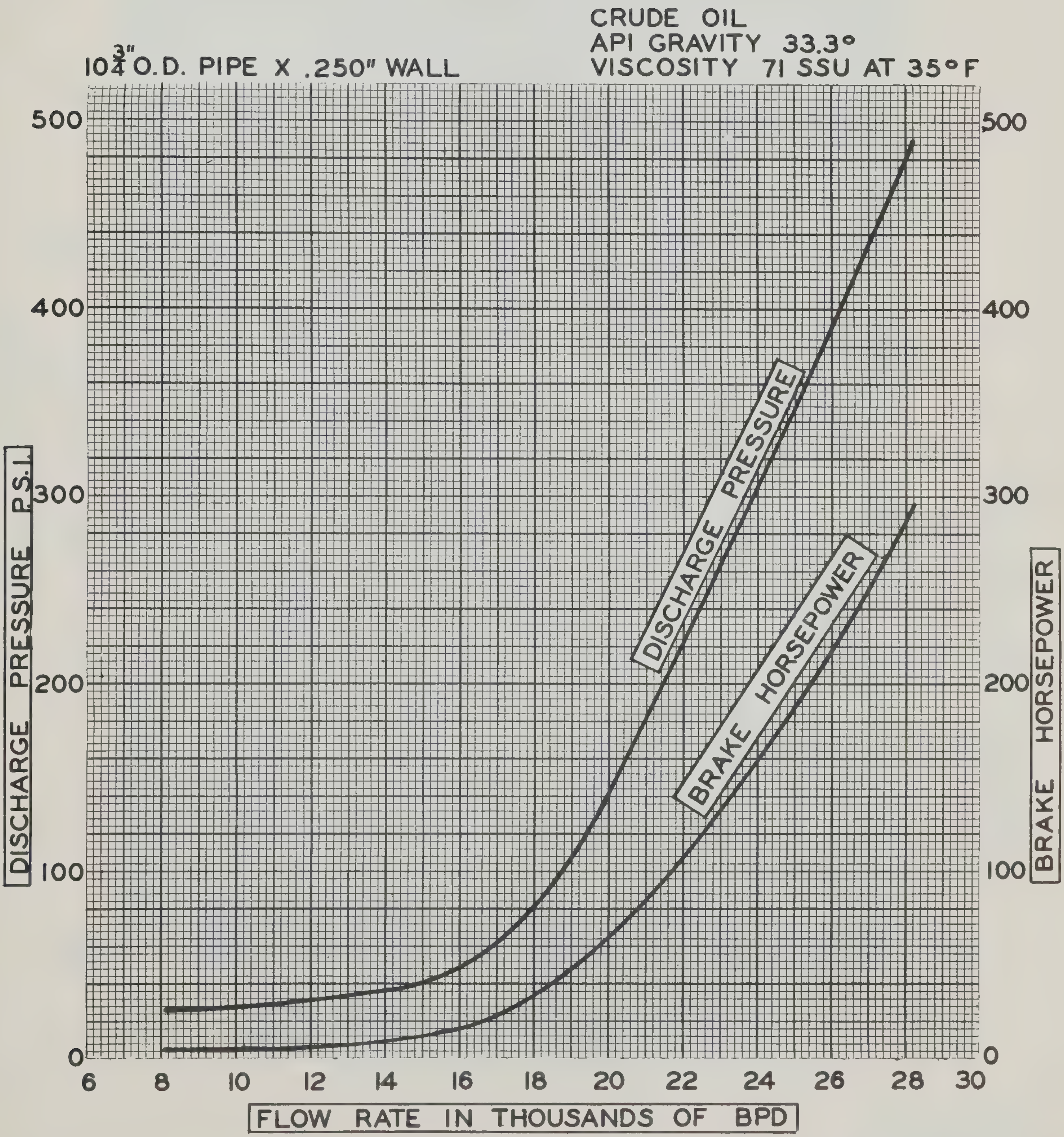


EXHIBIT 13

PRESSURE-FLOW-HORSEPOWER CURVES

BRITAMOIL JCT. - BELLSHILL LAKE

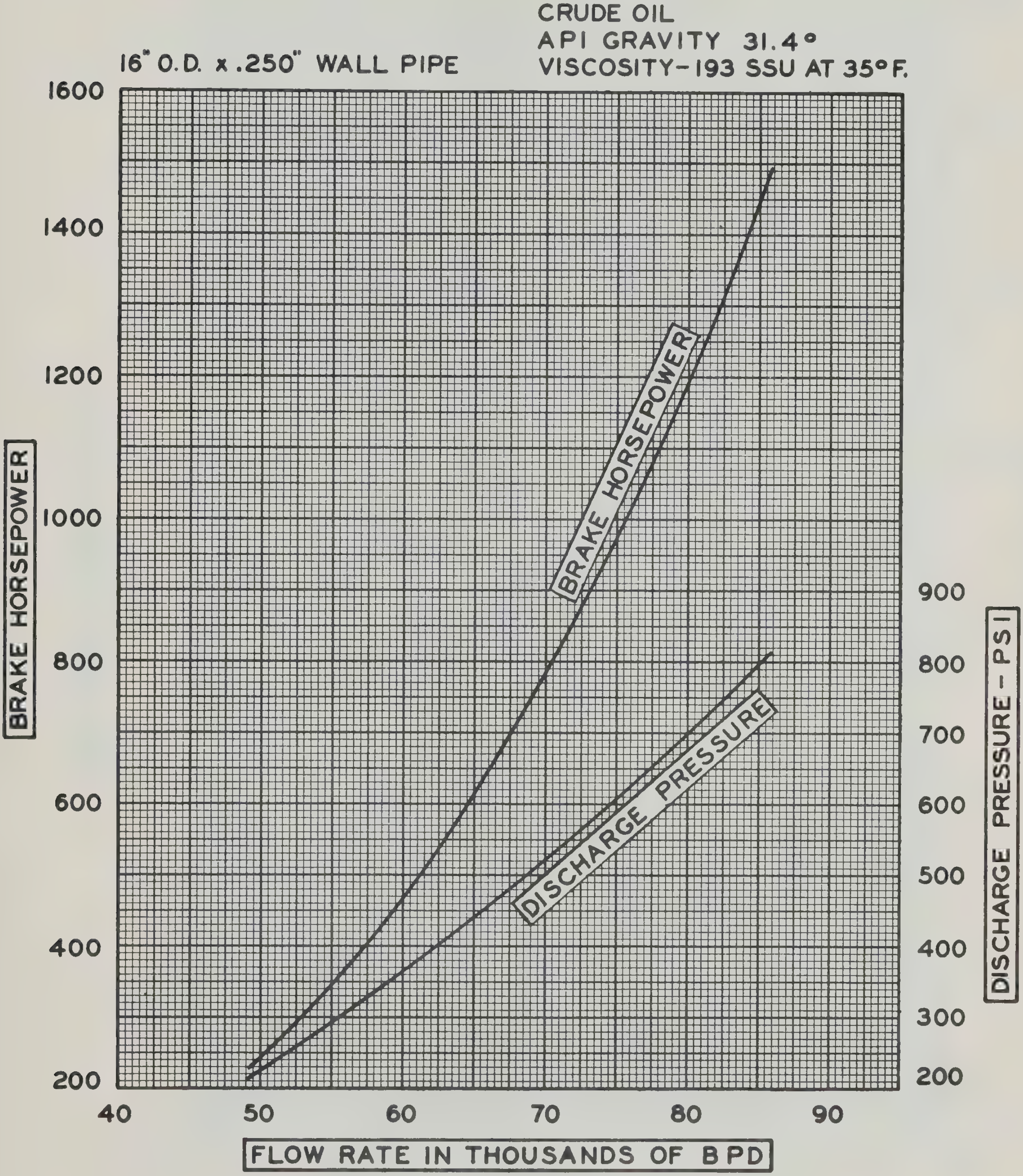


EXHIBIT 14

PRESSURE-FLOW-HORSEPOWER CURVES
EDMONTON-BELLSHILL LAKE

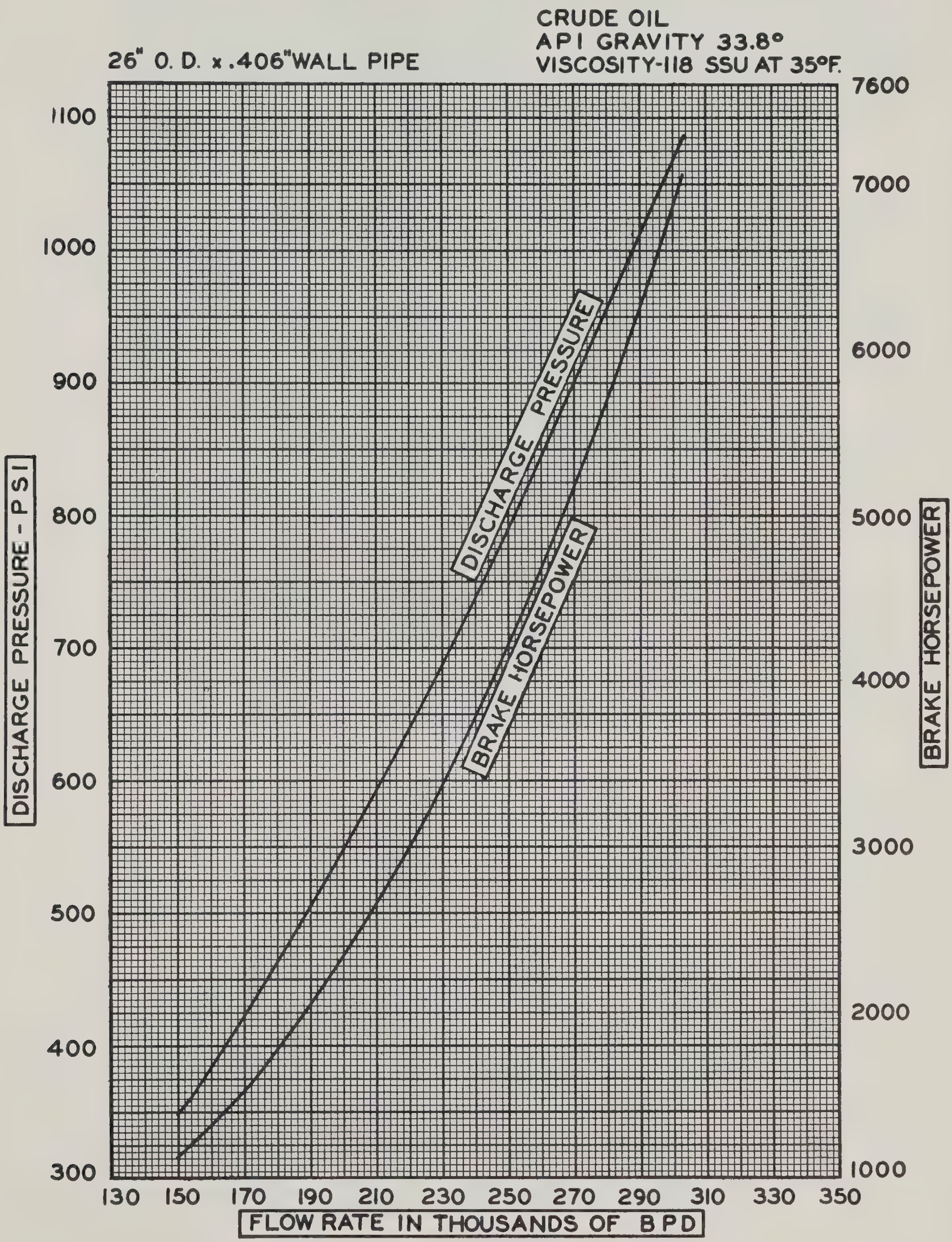


EXHIBIT 15

Main Line hydraulic studies were performed similarly to those for laterals. Preliminary studies show a 26-inch system as requiring too many pump stations with resulting excessive operating costs to make for an economic system with the throughput involved. Similarly, detailed studies show a 34-inch system involves too much pipe investment to be competitive for the throughput involved. Therefore, 30-inch systems were pursued for both the Northern and Southern Routes.

The total pressure required from Bellshill Lake to Montreal was calculated for the BPD throughput each year. Allowance was made for elevation differential and for 50 psi suction pressure at each pump station and the Montreal manifold. This suction allowance is liberal—part of this pressure could be used to increase flow during the extremely cold periods when marked increases in viscosity occur.

The total pressure required for tenth year (1969) throughputs was divided by an even number to obtain a reasonable station discharge pressure in accordance with the previously stated rule-of-thumb,

$$P = 1250 - 15D, \text{ or } 800 \text{ psi for } 30'' \text{ pipe}$$

The 50 psi suction pressure was added to each station discharge pressure, since only the differential affects the hydraulic gradient desired. An even number of stations is preferred so that alternate stations may be installed initially, and intermediate stations added when necessary as the throughput increases.

Eight stations were selected for the 30-inch Southern Route to be increased to 16 for 1963 throughput and beyond. If and when throughput exceeded about 400,000 BPD, it would appear more economical to loop the pipeline than to install an additional 16 stations.

The Northern Route, of almost identical length, was treated similarly--requiring identical stations as the Southern Route with one exception. Due to a hill near the Montreal terminal, a booster station is required at about MP 1837.5. Station horsepower requirements were calculated for both alternates as described for laterals.

Exhibit 16 following Page 32 shows the station discharge pressure and brake horsepower required for each station on the Southern Route for the throughput range under consideration. Both discharge pressure and brake horsepower naturally drop as shown on the Exhibit when intermediate stations are added. Friction loss was based on 3/8" wall pipe.

Station discharge pressures required over the ten-year period were compared with the allowable working pressure of various wall thicknesses of the 30-inch pipe, as previously tabulated. A wall thickness of 13/32" was selected for pipe at station discharge points. This thickness has an allowable working stress by the formula presented of 899 psi for 30-inch pipe.

Stations were located by using large scale profiles of one inch equals four miles horizontally, and one inch equals 400 feet vertically. Hydraulic gradients were drawn to locate stations, assuming 899 psi discharge pressure for stations on the 30-inch system. A suction pressure of 50 psi was allowed at each station and Montreal. All intermediate stations were considered--resulting in a total of 16 stations, including Bellshill Lake.

As discussed, the pressure in the pipeline at any point along the traverse corresponds to the difference in the elevation of the hydraulic gradient and the ground surface at the point in question. This difference in elevation may be called D. After plotting the hydraulic gradients including all future stations, the distance D was carefully examined along the entire traverse. Wherever D converted to psi fell within the allowable working pressure of thinner pipe, the milepost of the point was noted as the start of a different wall thickness. Thus the pipe wall was "telescoped" throughout the entire traverse to provide maximum economy of pipe conducive with projected throughput conditions.

It is interesting to note that in some cases D exceeded the allowable working stress of 13/32" wall pipe due to depressions in ground elevation. Therefore, some 7/16" wall pipe was required. A minimum wall thickness of 5/16" was used for both 30" alternates, as lesser walls in these sizes would be subject to excessive damage and defects during construction.

It is reiterated that discharge pressures of future intermediate stations were accounted for in the progressive

selection of wall thicknesses along the traverse. In many sections along the traverse D is greater before intermediate stations are considered than after. This may be easily demonstrated graphically, as the slope of the hydraulic gradient is increased for a given discharge pressure when additional stations are inserted.

A tabulation of wall thicknesses by mileposts is much too detailed for presentation in this report. However, a tabulation of pipe and wall thicknesses by Provinces and States is included in Chapter II under, Analysis of Pipe Requirements. From this tabulation it may be seen that average wall thickness is slightly less than 11/32".

From Exhibit 16 it is noted that the required discharge pressure in 1969 only, slightly exceeds the allowable working pressure of 13/32" wall pipe. The resulting stress is about 67 percent of yield strength, but heavier pipe was not considered for several reasons. (1) The required throughput is theoretical and may be closely approached with the allowable pressure. (2) A design wall thickness of 3/8" was used while the average actual wall thickness would be less than 11/32", allowing slightly increased flow. (3) The design suction pressures of 50 psi is liberal, and may be partially used to increase flow. (4) The design temperature of 35°F is well below the average flowing temperature anticipated.

The line length of the Northern Route is less than one per cent shorter than the Southern Route. Thus the discharge pressure and operating horsepower for a given flow rate is less than one per cent different for the two alternates. Such difference is about the width of the curve lines drawn on Exhibit 16. Therefore, Exhibit 16 represents both routes within the accuracy of plotting the curve.

On the Northern Route, a hill exists near Montreal so that a small booster station is required at most flow rates considered to raise the hydraulic gradient above the ground profile. As flow increases, the hydraulic gradient becomes steeper, so that less booster pressure is required. It is assumed the booster station would be temporary, remote controlled and located at approximately MP 1837.5 with 1100 HP installed. The net pressure and operating horsepower requirements of the booster station are tabulated as Exhibit 17.

PRESSURE-FLOW-HORSEPOWER CURVES
BELLSHILL LAKE-MONTREAL

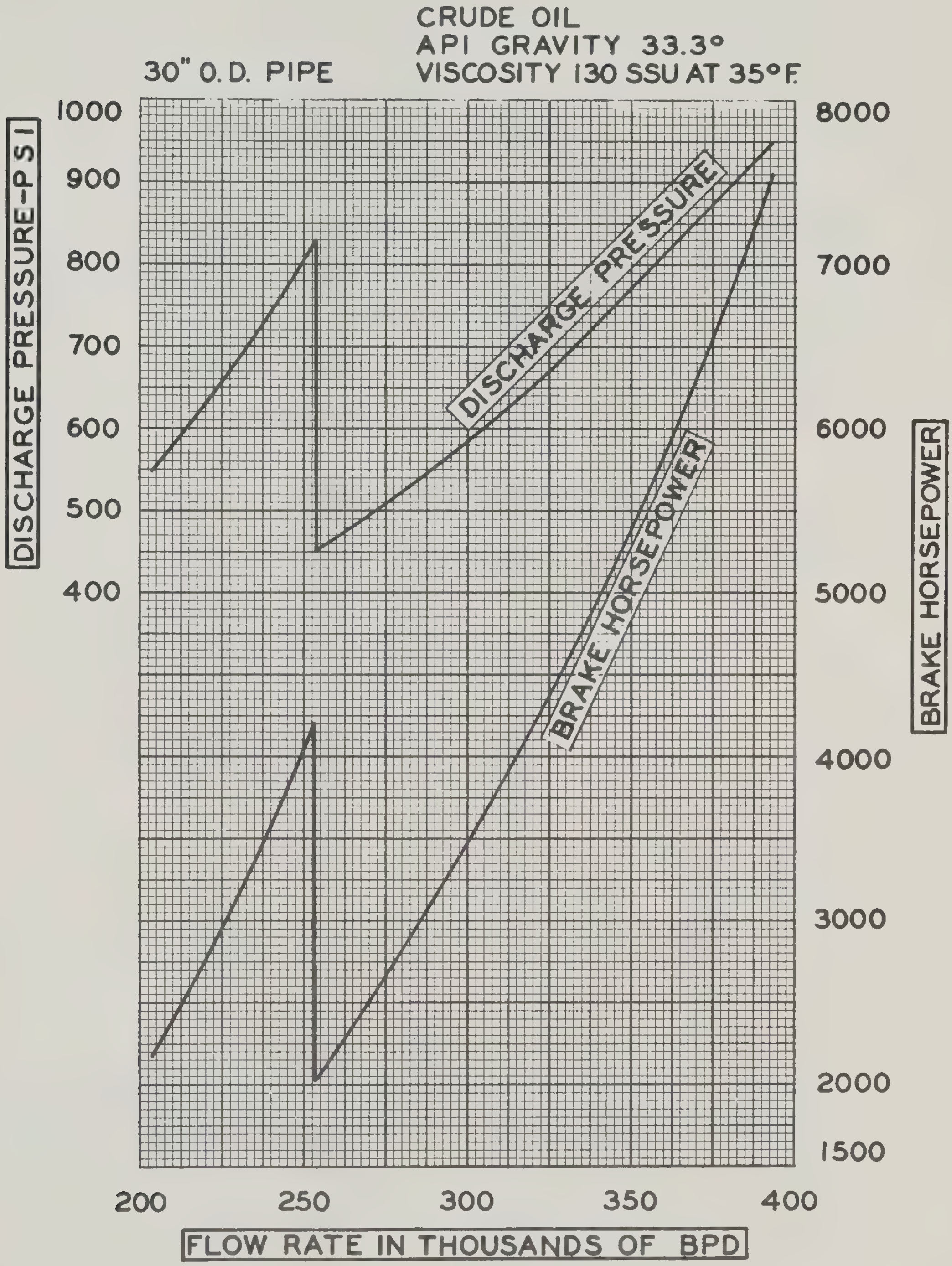


EXHIBIT 16

EXHIBIT 17

PRESSURE - FLOW - HORSEPOWER TABULATION

BOOSTER STATION, MP 1837.5

(Northern Route Only)

Year	Design Throughput MBPD	Net Pressure Required psi	Required Operating Horsepower
1960	204	233	1016
1961	228	209	1021
1962	253	180	976
1963	277	152	904
1964	302	122	785
1965	326	91	633
1966	343	67	488
1967	360	40	312
1968	377	12	96
1969	393	0	0

It is assumed this booster station would be unmanned -- remote controlled from the Montreal terminal. Two 550 HP pumping units would be installed initially.

E. DESCRIPTION OF PROPOSED FACILITIES

1. PIPELINE

The schematic diagram of the pipeline system, Exhibit 2, shows relative locations of all parts of the pipeline system. The table below shows pipe sizes and lengths for the system.

Pipe Sizes and Lengths

Section	Pipe Size OD, Inches	Pipe Length Miles
Calgary to Britamoil Junction	10-3/4	73.5
Britamoil Junction to Bellshill Lake	16	71.5
Edmonton to Bellshill Lake	26	100
Bellshill Lake to Montreal Southern Route	30	1,919
Northern Route	30	1,904

The entire pipeline will be coated and wrapped for corrosion protection, and buried to a depth that will allow a minimum of 36 inches of cover in soil, and 20 inches in rock. The coating will consist of a 3/32-inch minimum thickness coat of coal-tar-base enamel preceded by a primer. The pipe will then be wrapped with glass reinforcing wrap, followed by an outer wrap of 15 lb. asbestos felt. Both wraps are recommended for maximum protection of the enamel from damage due to extreme temperature, soil stress, and construction maintenance operation. The Construction Specifications, Volume II, present coating and wrapping procedures. In the event that other materials than specified show economic advantage without sacrificing quality, they may be substituted during final design.

Gate valves will be spaced along the pipeline at approximately 25 mile intervals to serve as safety cutoffs for isolation of sections of the pipeline for repairs of line breaks, maintenance and other contingencies. These gate valves are through-conduit type to allow passage of internal scrapers. For ready accessibility, each gate valve will be located adjacent to a highway. The above ground portion of

each gate valve will be protected by a steel box type shelter with hinged doors for access to the valve operator. Exhibit L shows a typical gate valve installation.

Casings will be installed at all points where the pipeline crosses Provincial or State Highways and railroads. Typical highway and railroad crossing details are shown on Exhibits B and C. The pipeline will be buried under all river and creek crossings as shown on Exhibit D.

The pipeline route will be marked by aerial route markers and ground markers to assist in patrolling the line and to provide reference points by which crews can be directed to pipe breaks or washouts. The pipeline will also be marked at all highway and railroad crossings. Markers are shown on Exhibits F and G.

Additional protection of the pipeline will be provided by the installation of electrolysis test stations as shown on Exhibit E. The tests at these stations will indicate the need for any corrosion protection. Corrosion protection, when needed, would probably consist of buried magnesium anodes. The outer flanges at each station will be insulated to prevent corrosive electrolytic currents.

The Construction Exhibits referred to above and other Construction Exhibits are included as Article 4 of this Section.

2. TANKAGE

a. General

Storage tank installations are planned at four stations. These are Calgary, Britamoil Junction, Edmonton and Bellshill Lake Stations. The tank sizes and capacities for each station are shown in the table below.

Initial Tankage

Location	Number Required	Capacity, Each	Size
Calgary	1	50,000 bbl.	86' dia. x 48'
Britamoil Jct.	1	30,000 bbl.	67' dia. x 48'
Edmonton	8	100,000 bbl.	134' dia. x 40'
Bellshill Lake	4	150,000 bbl.	150' dia. x 48'
	2	96,000 bbl.	120' dia. x 48'
	2	42,500 bbl.	80' dia. x 48'

Tankage to be installed in 1965

Location	Number Required	Capacity, Each	Size
Edmonton	3	100,000 bbl.	134' dia. x 40'
Bellshill Lake	2	150,000 bbl.	150' dia. x 48'
	1	96,000 bbl.	120' dia. x 48'
	1	42,500 bbl.	80' dia. x 48'

All storage tanks will be designed and constructed in accordance with the API Code. Standard storage tank appurtenances will be provided, including ground reading level gauges. Further study should be made to determine the need for tank bottom corrosion protection, tank agitators, tank heaters, remote reading tank level gauges and special exterior paint. Information available at this time indicates that these items will not be needed.

Each tank will be placed on a crowned pad of well compacted fill topped by a layer of oiled sand or asphalt, and will be located in a separate, well drained, firewall enclosure.

b. Storage Tank Capacity Selection Procedure

Calgary Station

The single 50,000 barrel storage tank to be installed at Calgary will be used in conjunction with two existing storage tanks. The 50,000 barrel size was selected as adequate added storage capacity to increase the total tankage to a volume that will allow continuance of existing deliveries to local refineries, and also provide a continuous crude stream for the Calgary Lateral to Britamoil Junction at the design flow rates.

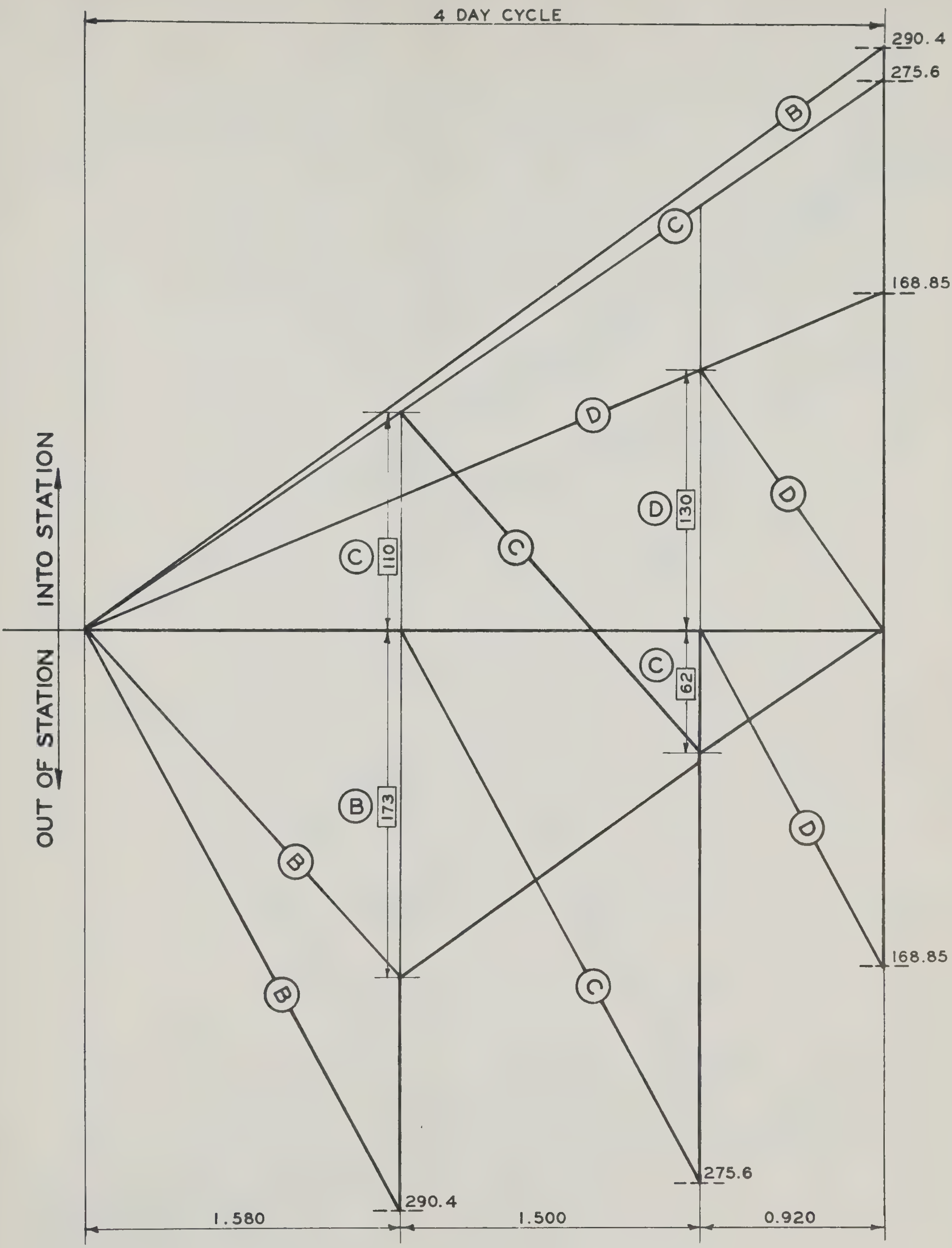
Britamoil Junction Station

The continuous incoming crude streams from Calgary and from the Britamoil line will be comingled in the single 30,000 bbl. storage tank. Station suction will be taken from the same storage tank. The 30,000 bbl. size was judged as adequate to handle this floating operation, allowing for fluctuations in the flow rates of either the incoming streams or the outgoing stream.

Edmonton

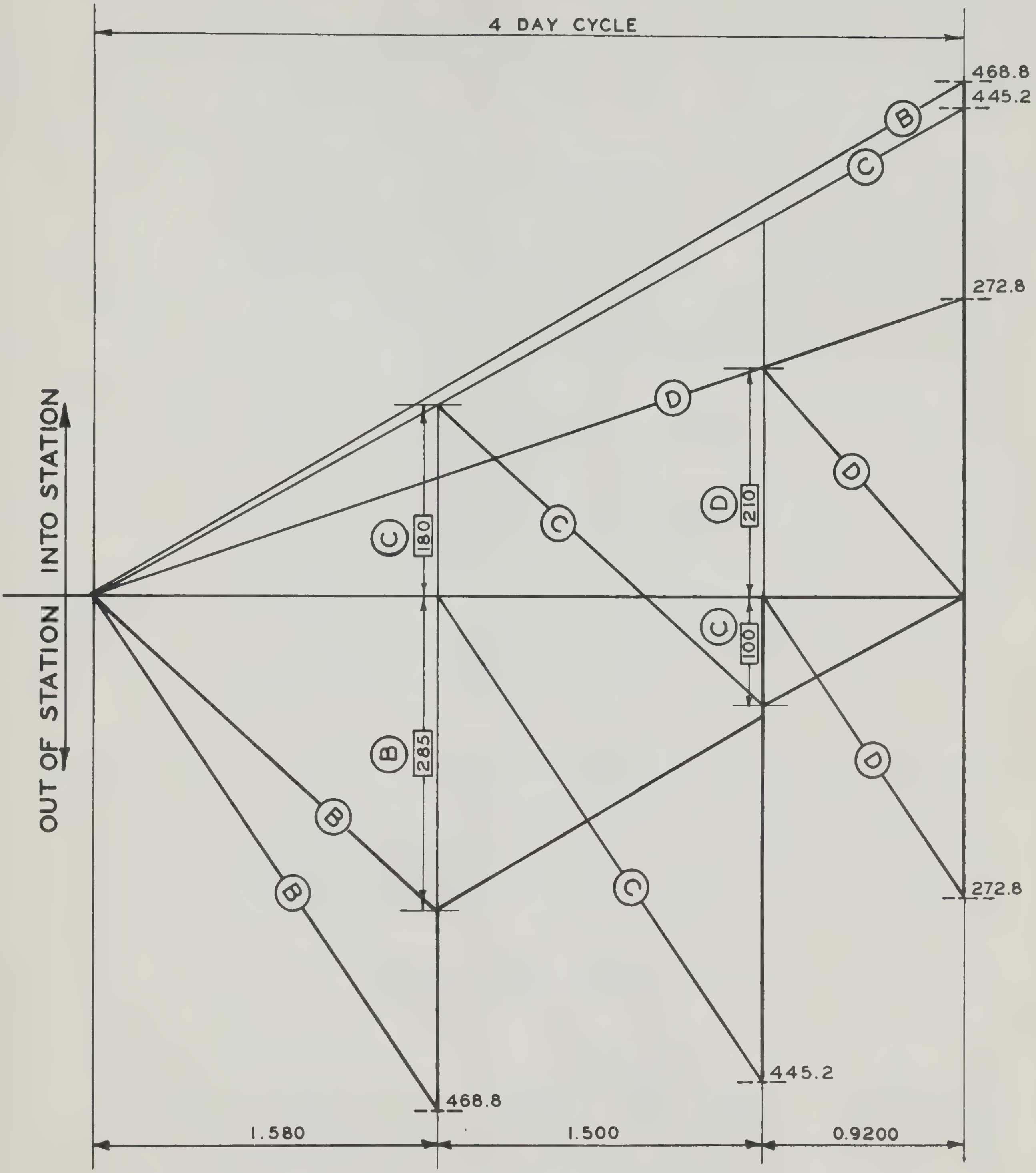
The selection of storage tank capacity at Edmonton is dependent on the scheduling procedure for the system. Three crude streams will each continuously enter the station into tankage. These are the Redwater, Pembina and Alberta Light crudes. The crudes will not be comingled and will require separate tankage. The crudes will be alternately batched from tankage through the line to the Bellshill Lake Station. The tankage must provide ample separate space for each of the three incoming streams, and allow adequate tank volume for crude build up to accommodate the outgoing stream. These two factors were carefully studied in order to reduce the investment cost in tankage to a minimum.

Exhibits 18 and 19 on the following pages show graphically the incoming volumes, the outgoing volumes and the resulting net storage space required to handle the streams at the station. The charts are based on an assumed four day cycle. Each of the three incoming streams will enter the station continuously during the four day cycle. A tender of each crude will be shipped out of the station to Bellshill Lake once during the cycle. The size of the tender will be dependent on the relative incoming rate for the particular crude. For example, the Pembina crude will have the largest incoming volume and as a result the outgoing tender will be the largest.



ALL VOLUMES IN THOUSANDS OF BARRELS
B-PEMBINA CRUDE
C-REDWATER CRUDE
D-ALBERTA LIGHT CRUDE

TANK SCHEDULING CHART
EDMONTON (1962)
EXHIBIT 18



ALL VOLUMES IN THOUSANDS OF BARRELS
B - PEMBINA CRUDE
C - REDWATER CRUDE
D - ALBERTA LIGHT CRUDE

TANK SCHEDULING CHART
EDMONTON (1969)

EXHIBIT 19

Referring to Exhibit 18: crude B (Pembina) is assumed as the first outgoing tender during the cycle, going out of tankage at a rate of 290,400 bbls. per 1.58 day period; crude B is also entering tankage at the rate of 290,400 bbls. per four day period; after 1.58 days of crude B shipment, the stream is switched to crude C (Redwater); during the remainder of the cycle crude B is incoming only and will fill the tanks in preparation for the next shipment; as shown on Exhibit 18 the required minimum tankage for crude B is the net difference in outgoing and incoming volumes at the end of the 1.58 day shipping period, which is 173,000 bbls. Tankage for crude C is analyzed in a similar manner: crude C enters tankage continuously during the four day cycle at the rate of 275,600 bbls. per four days; after 1.58 days have elapsed shipment of crude C begins, at which time 110,000 bbls. have entered the tanks; crude C is shipped at the rate of 275,600 bbls. per 1.50 days after which the outgoing stream is switched to crude D (Alberta Light); as shown on Exhibit 18 the required minimum tankage for crude C is the volume of incoming crude C accumulated at the time shipment began (110,000 bbls.) plus the net difference in volumes of outgoing and incoming crude at the time shipment of crude C ended (62,000 bbls.), making a total of 172,000 bbls. of required storage capacity; after shipment of crude C ends the incoming stream will replenish the tankage. Crude D tankage is evaluated in a similar manner to arrive at a minimum tankage of 130,000 bbls.

The initial tankage requirements are based on Exhibit 18. The volumes shown on Exhibit 18 are those predicated for 1962. However, the tankage selected will be adequate until 1965. In 1965 added tankage will be installed based on Exhibit 19 which shows volumes predicted for 1969. A summary of the theoretical minimum required tankage and the actual tankage selected is presented below.

Total Edmonton Tankage Capacity
(Thousands of Barrels)

		Theoretical Minimum			Installed	
	Crude	1962	1965	1969	1960	1965
B	Pembina	173	221	285	300	400
C	Redwater	172	219	280	300	400
D	Alberta Light	130	166	210	200	300

The installed tankage has been selected to include approximately 50 percent greater volumes than the theoretical minimum volumes to allow for some flexibility in scheduling and to allow for possible variations in incoming and outgoing flow rates.

Bellshill Lake Station

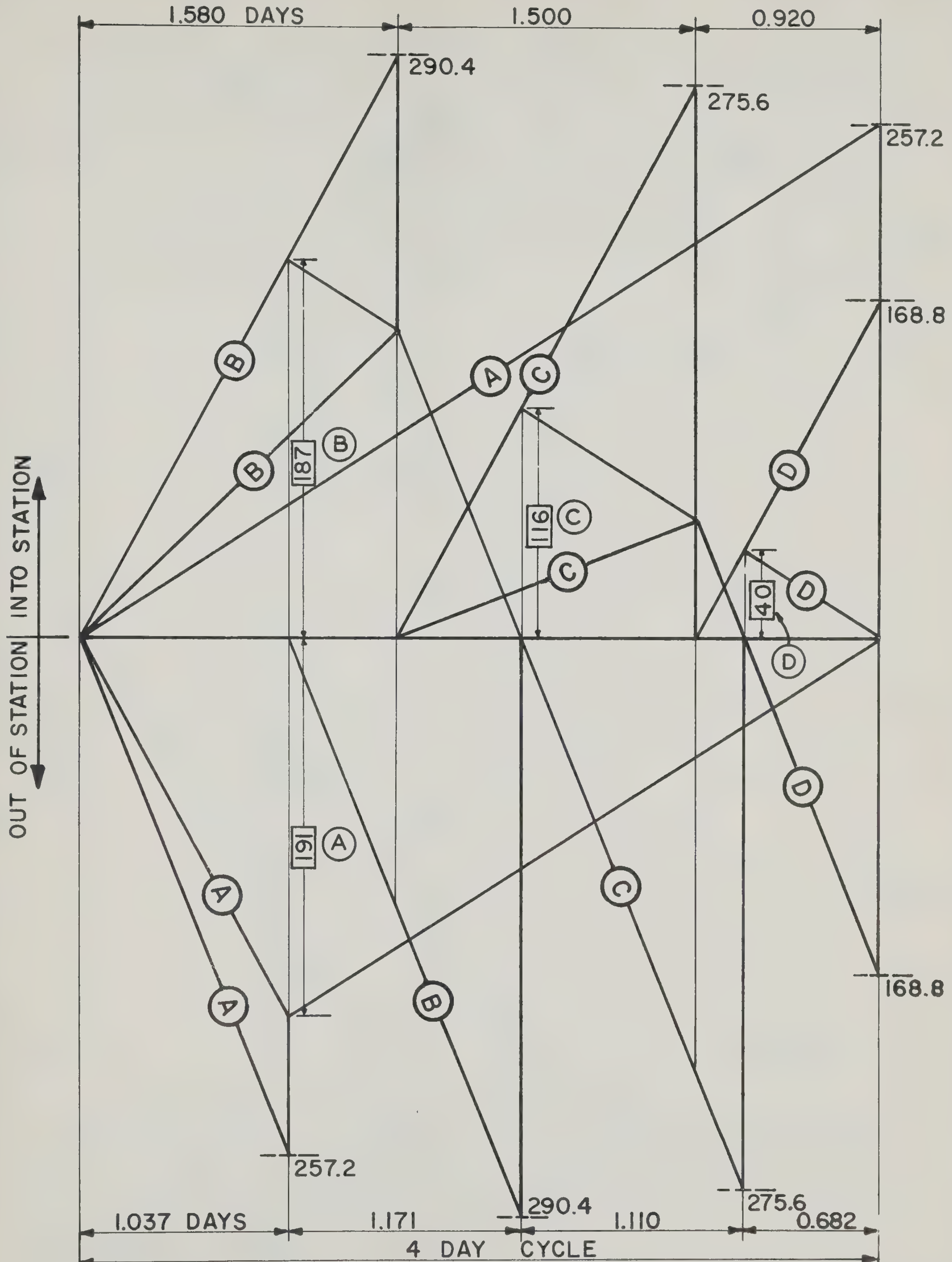
The Bellshill Lake Station has a very similar scheduling situation to that described above for the Edmonton Station. The three crudes from Edmonton will arrive in separate tenders, and will be directed to separate tankage. A fourth set of tanks is required in which the two incoming streams from Britamoil Junction and Bellshill Lake Field will be comingled. These two streams will arrive continuously during the entire four day cycle. The four crudes will each be tendered to Montreal once during the assumed four day cycle.

Exhibits 20 and 21 are charts similar to those described above which show the analysis for determining the theoretical minimum required tankage for each crude. The table below is a summary of theoretical minimum versus installed tankage.

Bellshill Lake Tankage Capacities
(Thousands of Barrels)

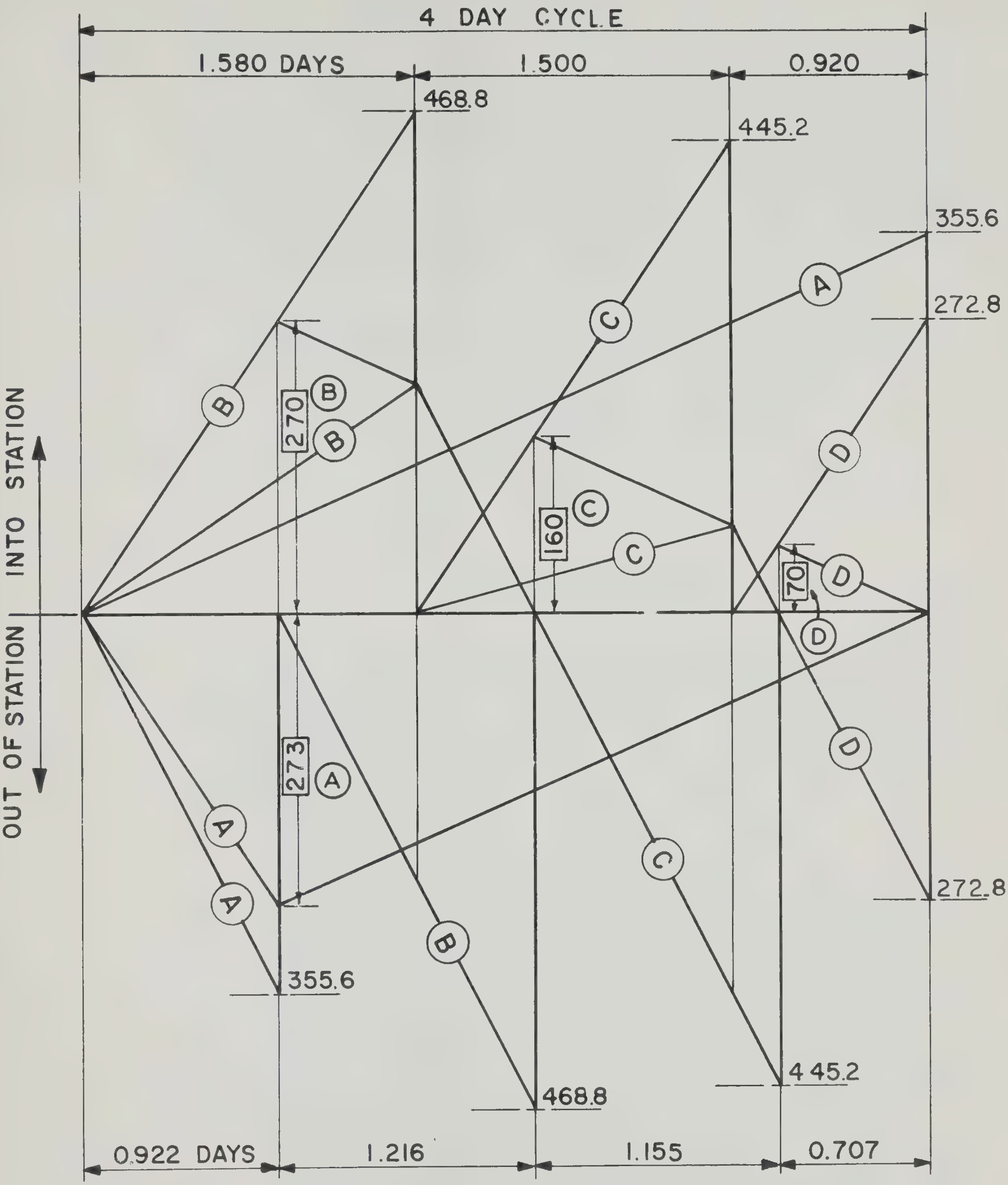
		Theoretical Minimum			Installed	
	Crude	1962	1965	1969	1960	1965
A	Britamoil and Bellshill Lake	191	247	273	300	450
B	Pembina	187	243	270	300	450
C	Redwater	116	150	160	192	288
D	Alberta Light	40	60	70	85	127.5

Here, as at Edmonton, the installed tankage will be approximately 50 percent greater than the theoretical minimum, in order to provide continuous, flexible operation.



ALL VOLUMES IN THOUSANDS OF BARRELS
A - CALGARY & BELLSHILL LAKE CRUDE
B - PEMBINA CRUDE
C - REDWATER CRUDE
D - ALBERTA LIGHT CRUDE

TANK SCHEDULING CHART
BELLSHILL LAKE (1962)
EXHIBIT 20



ALL VOLUMES IN THOUSANDS OF BARRELS

A - CALGARY & BELLSHILL LAKE CRUDE
B - PEMBINA CRUDE
C - REDWATER CRUDE
D - ALBERTA LIGHT CRUDE

TANK SCHEDULING CHART
BELLSHILL LAKE (1969)
EXHIBIT 21

3. STATIONS AND TERMINAL

a. General

As shown on the Route Map, Exhibit 1, both alternate systems will include pumping stations at Calgary, Britamoil Junction, Edmonton and Bellshill Lake with a terminal at Montreal. The number of intermediate Main Line stations will vary with Main Line route, considering the booster station on the Northern Route as a station. The table below shows the number of intermediate Main Line stations for each alternate.

Total Number of Intermediate Main Line Pumping Stations

Year	Southern Route	Northern Route
1960	7	8*
1963	15	16*

* Including Booster Station

All stations will be similar in many respects. The facilities that are typical for all stations will be described in the paragraphs below. The particular arrangement of each station will be described in subsequent paragraphs. Exhibits 23 through 30 show schematic arrangements for main stations, indicating the main facilities to be installed.

Office Building (Refer to Exhibits 29 and 30)

An office building will be erected at each main station and at the terminal, which will include: main office and control area; garage, storage and workshop area; locker room; switchgear and motor control center room; and boiler room. The building will be of double wall construction with concrete block on the inside and face brick on the exterior. The floor will be concrete slab, covered with composition tile, and the ceiling will include acoustical tile and insulation.

The office and control area will include space for the control console, control and recording instruments, communications equipment and office furniture. The garage will include space for storage, and provisions for repair work on instruments and equipment. The switchgear room will house the switchgear, motor control centers and relay cabinets.

The locker room will include lockers, water closet, wash basin and shower facilities for the personnel attached to the station. The boiler room will include a boiler for office building heating, instrument air compressor, air tank, air dehydrator, water pump, water softener, water system pressure tank and hot water heater. Steam heat will be provided throughout the building. Ample building lighting and electrical outlets will be provided.

Pump House (Refer to Exhibit 30)

A separate pump house will be erected at all stations except at Calgary and at the Montreal terminal. The pump house, which primarily houses the main pump units, will be of all metal construction and fully insulated. The floor will be concrete slab, surfaced with Masterplate. All pump houses containing diesel engine units will require a concrete block firewall between pumps and engines.

The pump house will also house the diesel-electric generator units for station power in cases where local power is not available. Other equipment located in the pump house will include the air compressor and air storage tanks for engine starting air, fuel oil day tanks, centrifuges and an explosive gas mixture warning system for the pump area. An interconnecting passageway will join pump house and office building for use during inclement weather.

Main Pump Units

Diesel engines with centrifugal pumps connected through a speed increaser have been tentatively selected as the main pumping units for all stations, as it is assumed that low cost electric power will not be available at the majority of the locations. Further detailed investigation may show that electric motor driven units will be feasible at some locations. The engines preliminarily selected are dual-fuel engines able to use diesel fuel, natural gas and some grades of crude oil. The use of crude oil will reduce the fuel cost. However, the use of some crudes may result in added maintenance cost offsetting the savings in fuel.

As shown on the exhibits, all main pump units are connected in series. Detailed investigation may indicate that the future units should be added in parallel to the

initial units. It may also prove feasible to add the future units to the downstream side of the initial units instead of to the upstream side as shown on the exhibits. Considerable detailed study must be made before final pump unit selection.

Station Piping

All station piping, fittings and valves at the pump manifolds and downstream of the pump units will be designed for ASA 600 lb. pressure rating. Tank piping, tank manifold piping, strainer piping and other piping upstream of the main pumps will be designed for ASA 150 lb. pressure rating where possible. The above ground pipe will be painted. The buried pipe will be coated and wrapped.

Ample supports and anchors for above ground piping will be installed. Platforms and catwalks for access to valves will be provided. Dual basket type strainers are included in the station manifold line upstream of the main pumps. Each strainer will handle full flow and will be operated alternately, allowing cleaning during the off cycle.

Scraper Traps

Scraper traps will be installed at each station to permit cleaning the main line by pigging. Each scraper trap will include a quick disconnect cover for fast pig removal and a bypass line to be used when launching or receiving the pig.

Meters

Meters will be installed at Calgary, Britamoil Junction, Bellshill Lake and Montreal. The sheltered metering installations will include P. D. type meters, strainers, prover tank, sump and pump to service prover tank and sump. The meters will be equipped with counters and ticket printers. Equipment supports and access platforms will be installed.

Electrical

It is assumed that local electrical power for miscellaneous station needs will be available at Calgary, Britamoil Junction, Edmonton, Bellshill Lake and Montreal. It is also assumed that local power will not be

available at the intermediate stations. The intermediate stations will each require the installation of one 60 KW diesel-electric generator set and one 40 KW set as a standby.

These units will supply electric power for miscellaneous station needs including building lighting, communications, controls, small motors, shop equipment and personnel quarters. Switch-gear for the generators will be located in the office building. Yard lights will be provided at all operating areas. All facilities will be grounded.

Instrumentation and Controls

A summary of the instrumentation and controls is presented below. This applies to all stations unless otherwise noted. The center of the control system will be the control console located in the office.

(a) The control console will include the following:

(1) Schematic of station with switches and operation indication lights for booster pump and motor operated valves (no booster pump at intermediate stations). Operation indication lights only for main pump units and radiator operation.

(2) Automatic controllers and recorders for station discharge pressure, station suction pressure, and station flow. Recorders actuated by changes in air pressure from pressure cells located on manifold.

(3) Warning by lights and by buzzer and horn of:

High station discharge pressure
Low station suction pressure
Station flow not within desired range
High engine speed
High pump bearing temperature
High pump case temperature
Pump seal failure
High sump level
Instrument air failure

(4) Emergency shutdown switch for pump units.

(5) Automatic pump unit shutdown in event of:

High station discharge pressure
Low station suction pressure
High engine speed
High engine jacket water temperature
Low engine lube oil pressure
High pump bearing temperature
High pump case temperature
Pump seal failure

(6) Automatic equipment for engine control during warm up period.

(b) The engines will be started at the instrument panel mounted on their respective engine unit. The engine instrument panels will also include the following:

(1) Visual indication of:

Engine speed
Engine jacket water temperature
Engine jacket water pressure
Engine lube oil temperature
Engine lube oil pressure
Engine fuel oil pressure
Engine exhaust temperature

(2) Warning by lights and by buzzer or horn of:

High engine jacket water temperature
Low engine lube oil pressure

(c) Other controls and instrumentation provided in the station include:

(1) Recording thermometer for outgoing crude.
(2) Direct reading pressure gauges at manifold, strainers, booster pump, scraper trap.
(3) Station shutdown switch outside building.
(4) Mercoid switches for shutdown for pump bearing temperature and pump case temperature will be located on small rack immediately adjacent to each pump.
(5) Outgoing gravity measurement.

Communications

It is assumed that all voice and teletype communications will be by leased wire.

Fuel System

A 1,000 bbl. fuel tank will be provided at each station (except Calgary and Montreal) to store either diesel oil or crude oil for engine fuel. It is assumed the crudes transported will prove satisfactory for engine use. The crude may be taken from the Main Line into the fuel tank. The tank will be a cone roof type, enclosed by a firewall and will be equipped with steam coils to heat the fuel. Piping will be provided from the fuel tank to a 30 bbl. fuel day tank in the pump house.

Centrifuges will be required to purify the crude oil when used as fuel. The crude will pass through the centrifuge before entering the day tanks. As crude oil may be used as fuel, it is advisable to install a separate 30 bbl. diesel fuel day tank for emergency use and to use when running down the engines in order to maintain clean nozzles.

Drain System

Each station will require an oil drain system to receive crude oil drainage from station piping and equipment. This will include a sump tank with lines from scraper traps, pumps and manifold piping. A rotary vane type pump will be installed to pump out the sump tank to the suction side of the station.

The large metering installations will have separate sump tanks and pumps. The sump tanks will be equipped with a three position control switch which will automatically start the sump pump when the sump is full, and will stop the sump pump when a low level is reached. The third and highest position will cause an alarm when the sump is near overflow.

Water System

It is assumed that water will be available at all locations from wells or streams. A water pump, pressure tank and water softener will be installed for station needs. The engines will be water cooled which requires the installation of fan cooled radiator units for each engine. Precautions will be taken to prevent

freezing of the water lines.

Sewage System

The sewage system at each station will include a septic tank with an adequate drain field.

Fire Fighting Equipment

Portable, foam type, fire fighting equipment will be installed in the office building, pump house and will be strategically located in the operating areas.

Yard Improvements

All station sites will be graded to assure proper drainage and good appearance. Sidewalks will be provided between work areas, and needed area roads will be built. Station areas will be fenced.

Staff Housing

It is assumed that staff housing will be required at all stations with the exception of Calgary, Edmonton, Montreal, and two other stations. Adequate housing was estimated to consist of four houses and a dormitory.

b. Calgary Station (Refer to Exhibit 23)

The initial installation at the Calgary Station will include a 50,000 bbl. storage tank, 20 HP electric drive booster pump, sheltered metering area with two three-inch meters, office building and outgoing scraper trap.

The new storage tank will be manifolded with the two existing storage tanks to receive crude from the field and provide crude to the pipeline. Initially the 20 HP booster pump will furnish enough total pumping capacity for the station. The crude will be metered, as tank gauging does not appear to be feasible for custody transfer since crude from the tankage will be delivered to local refineries simultaneously with deliveries to the pipeline.

Future expansion will include a pump house and a 150 HP centrifugal pump unit in 1963. A second 150 HP pumping unit and a third three-inch meter will be added in 1965.

c. Britamoil Junction Station (Refer to Exhibit 24)

Initially at Britamoil Junction the facilities will include an incoming scraper trap, sheltered metering installations for each of the incoming streams, a 30,000 bbl. storage tank, 75 HP booster pump, two 600 HP engine driven centrifugal pump units, office building, pump house and outgoing scraper trap.

The metering installation will include three six-inch meters for the incoming stream from the Britamoil line, and two three-inch meters for the incoming line from Calgary. Both streams will be comingled in the storage tank and drawn out as one main stream to Bellshill Lake. The tank will be floating on the line and gauging will not be feasible for custody transfer. The 75 HP booster pump will supply 50 psi suction pressure to the main pumps.

Future additions will include a 25 HP booster pump in 1963, a third 600 HP main pump unit in 1964, and a third three-inch meter in 1965.

d. Edmonton Station (Refer to Exhibit 25)

The Edmonton Station will initially include eight 100,000 bbl. storage tanks, three 75 HP tank booster pumps, one 250 HP main booster pump, dual strainers, two 1,000 HP engine driven centrifugal pump units, pump house, office building and outgoing scraper trap.

The three incoming streams will be handled in separate tankage. Each crude in its turn will be tendered from tankage through the Main Line to Bellshill Lake. The tank valves, tank manifold valves and pump manifold valves will all be motor operated and controlled from the office to enable quick and convenient tank switching and pump startup.

Future expansion will include: the addition of a 100 HP main booster pump and a 2,000 HP main pump unit in 1962; a pump house extension, one 2,000 HP main pump unit and three 100,000 bbl. storage tanks in 1965; and a 2,000 HP pump unit in 1967. Metering of the incoming stream may be desirable in the future. Initially the storage tanks will be gauged for custody transfer. Consideration should be given to the need for sampling and BS and W monitoring facilities.

e. Bellshill Lake Station (Refer to Exhibit 26)

The Bellshill Lake Station will include incoming scraper traps for the lines from Britamoil Junction and Edmonton, sheltered metering areas for each of three incoming lines, four 150,000 bbl. storage tanks, two 96,000 bbl. tanks, two 42,500 bbl. tanks, four 100 HP tank booster pumps, one 250 HP main booster pump, dual strainers, office building, pump house, two 2,000 HP engine driven centrifugal pump units and an outgoing scraper trap.

The three incoming streams will be from Edmonton, Britamoil Junction and Bellshill Lake Field. The Edmonton stream will include three batched crudes. The streams from Britamoil Junction and Bellshill Lake Field will be comingled at the station. This means that four crudes must be handled separately in the station. The Edmonton stream will be metered with four 10-inch meters, the Britamoil Junction stream with three 6-inch meters and the Bellshill Lake Field stream with two 3-inch meters.

Each crude will be directed to a separate group of tanks through an incoming manifold. The four crudes will be alternately tendered out of tankage in cycles through the outgoing manifold into the Main Line to Montreal. The tank valves, incoming manifold valves, outgoing manifold valves and the pump manifold valves will all be motor operated with control from the office.

Future expansion will require: one 100 HP booster pump in 1963; two 100,000 bbl. tanks, one 96,000 bbl. tank, one 42,500 bbl. tank and one 2,000 HP main pump unit in 1965; and one 2,000 HP pump unit and pump building extension in 1968.

f. Typical Intermediate Station (Refer to Exhibit 27)

The initially installed facilities will include incoming scraper trap, dual strainers, two 2,000 HP engine driven main pump units, pump building, office building, outgoing scraper trap and personnel housing. A bypass line will be provided to allow bypass of a shutdown station. Pump manifold valves will be motor operated with control from the office.

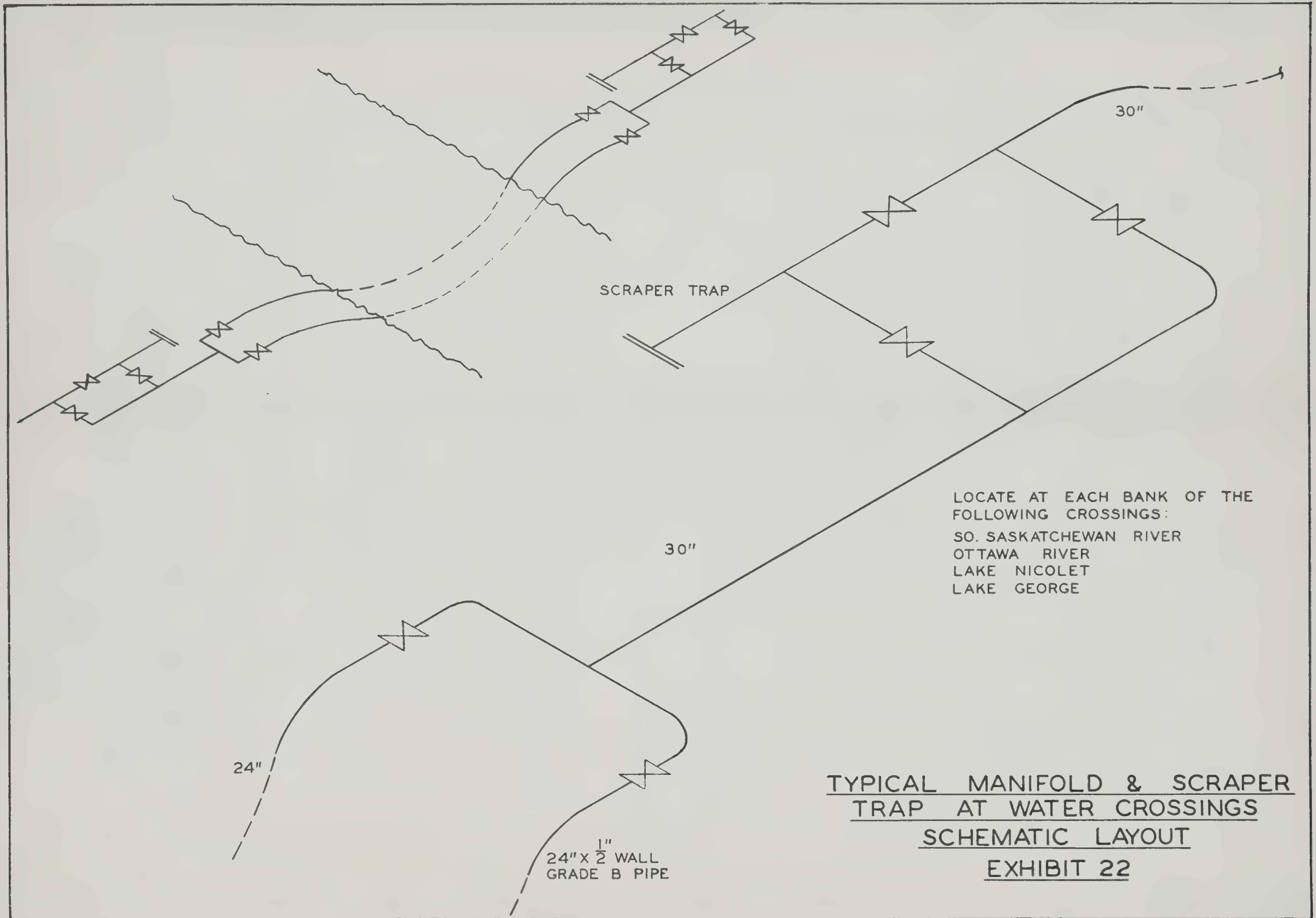
Future added facilities will include: one 2,000 HP pump unit in 1965; one 2,000 HP pump unit in 1968.

g. Booster Station (Northern Route Only)

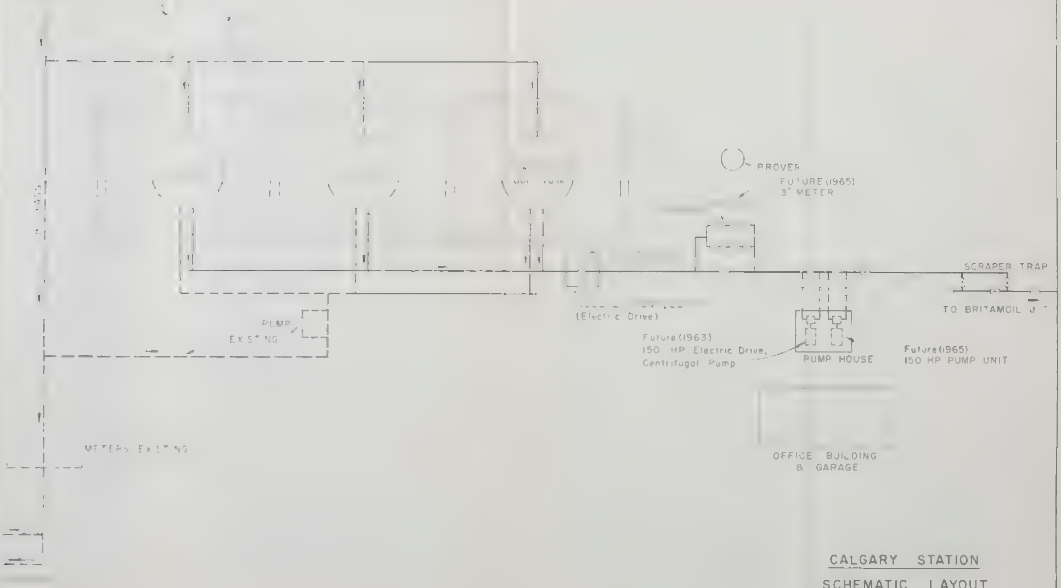
This temporary station at approximately MP 1837.5 would contain two 550 HP pumping units. The station would be unmanned, operated remotely from the Montreal terminal. Only functional facilities would be installed, as the station serves no useful purpose when the tenth-year throughput is attained.

h. Montreal Terminal (Refer to Exhibit 28)

The Montreal terminal will include an incoming scraper trap, sheltered metering installation with four 10-inch meters, office building and a delivery header. Deliveries will be made to refineries in the Montreal area. The valves on the delivery manifold will be motor operated and controlled from the office. Pipeline ownership will include the delivery manifold valves. Future additions will include one 10-inch meter in 1963 and one 10-inch meter in 1965.



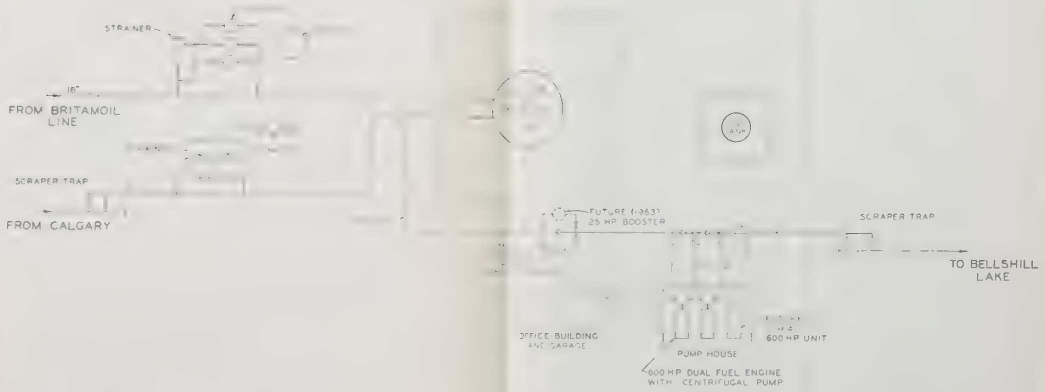
TYPICAL MANIFOLD & SCRAPER TRAP AT WATER CROSSINGS
SCHEMATIC LAYOUT
EXHIBIT 22



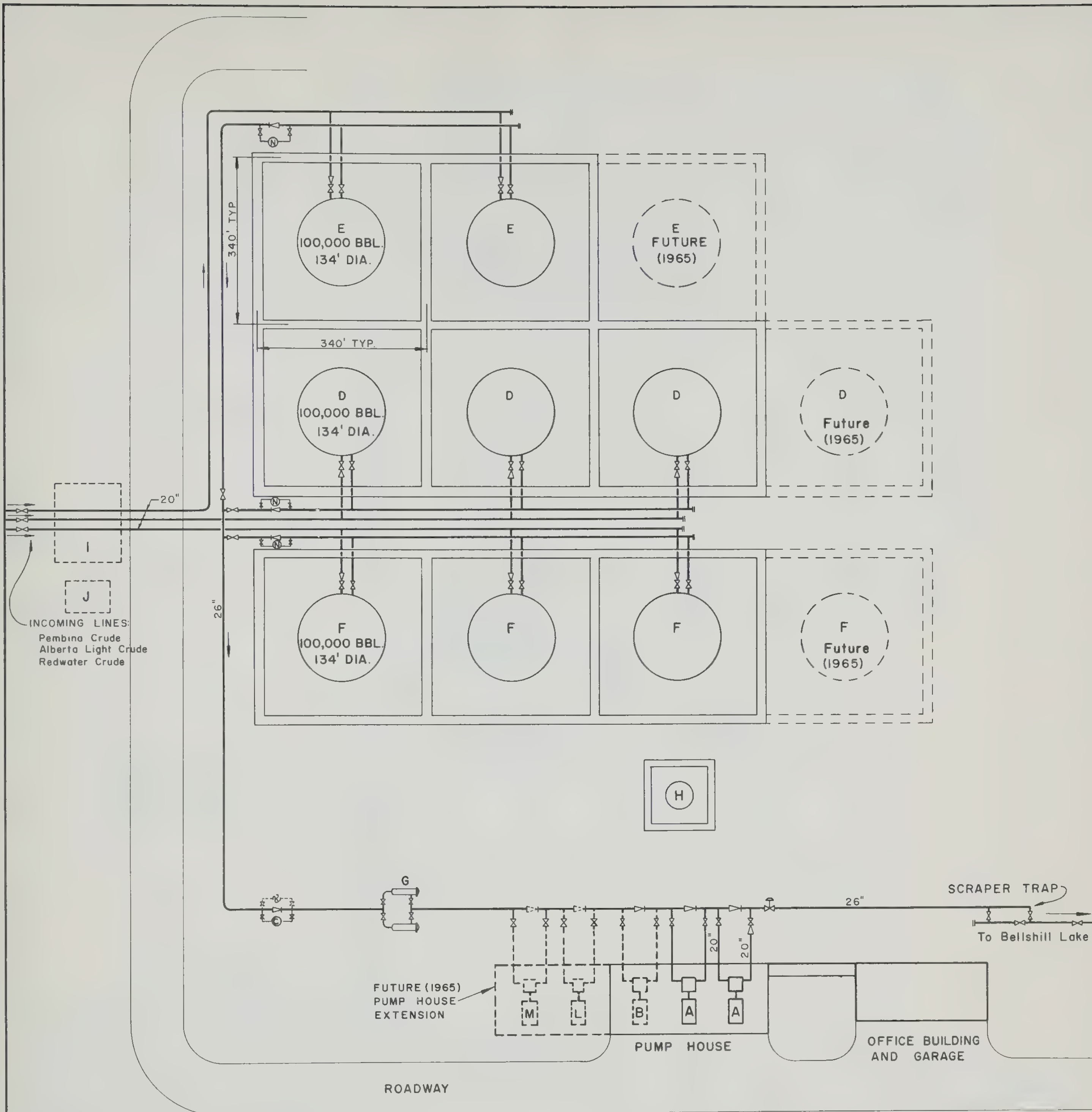
CALGARY STATION

SCHEMATIC LAYOUT

EXHIBIT 23



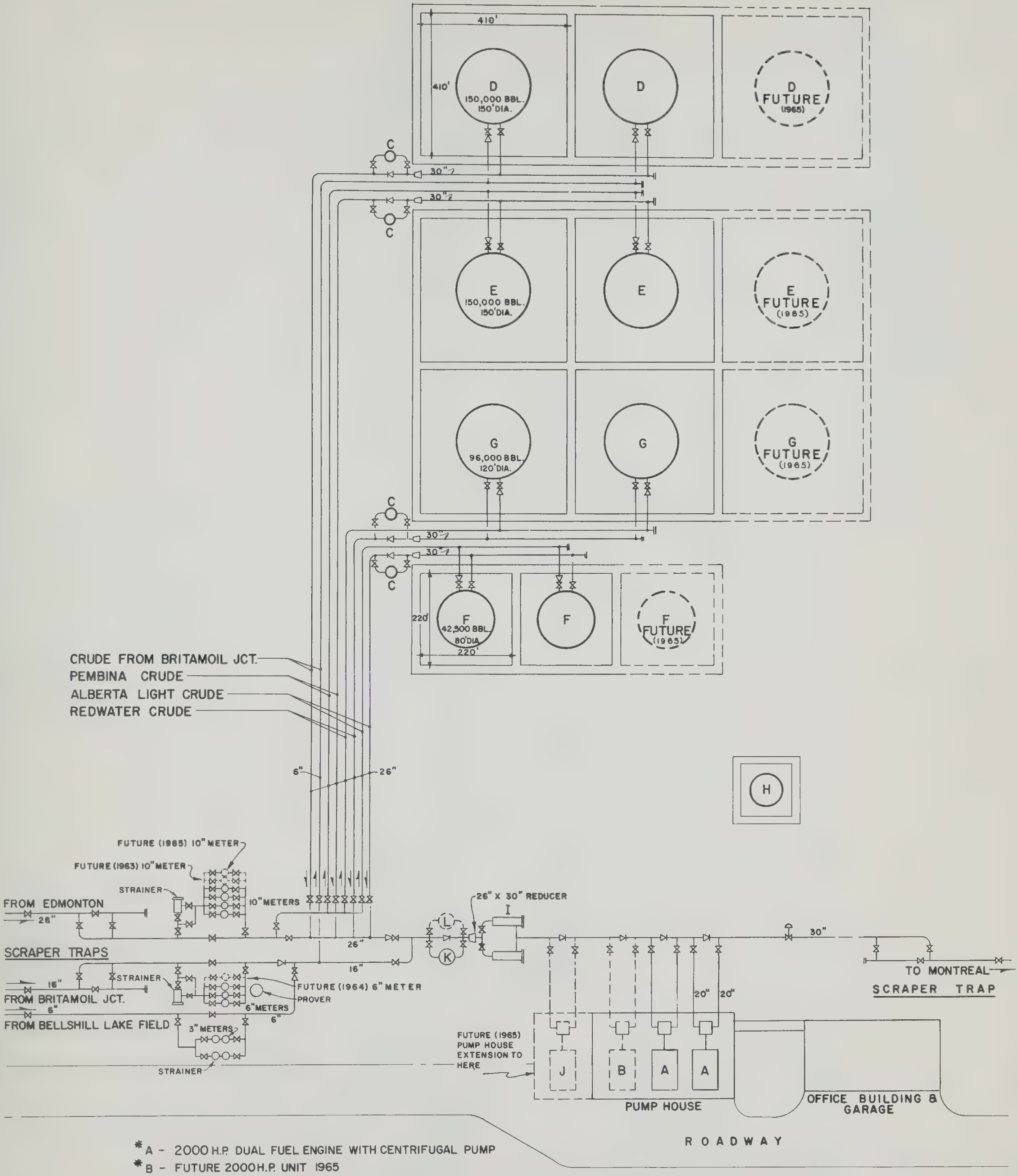
BRITAMOIL JCT STATION
SCHEMATIC DIAGRAM
EXHIBIT 24



A – 1000 HP Dual-Fuel Engine With Centrifugal Pump
B – Future (1962) 2000 HP Dual-Fuel Engine With Centrifugal Pump
C – 250 HP Booster Pump, Electric Drive
D – Storage Tanks – Pembina Crude; 100,000 Bbl; 134' x 40'
E – Storage Tanks – Alberta Light Crude; 100,000 Bbl; 134' x 40'
F – Storage Tanks – Redwater Crude; 100,000 Bbl; 134' x 40'
G – Dual Strainers
H – Fuel Tank
I – Future Metering Area
J – Future Sampling And Testing Building
K – Future (1962) 100 HP Booster Pump
L – Future (1965) 2000 HP Pump Unit
M – Future (1967) 2000 HP Pump Unit
N – 75 HP Booster Pump, Electric Drive

EDMONTON STATION
SCHEMATIC LAYOUT

EXHIBIT 25

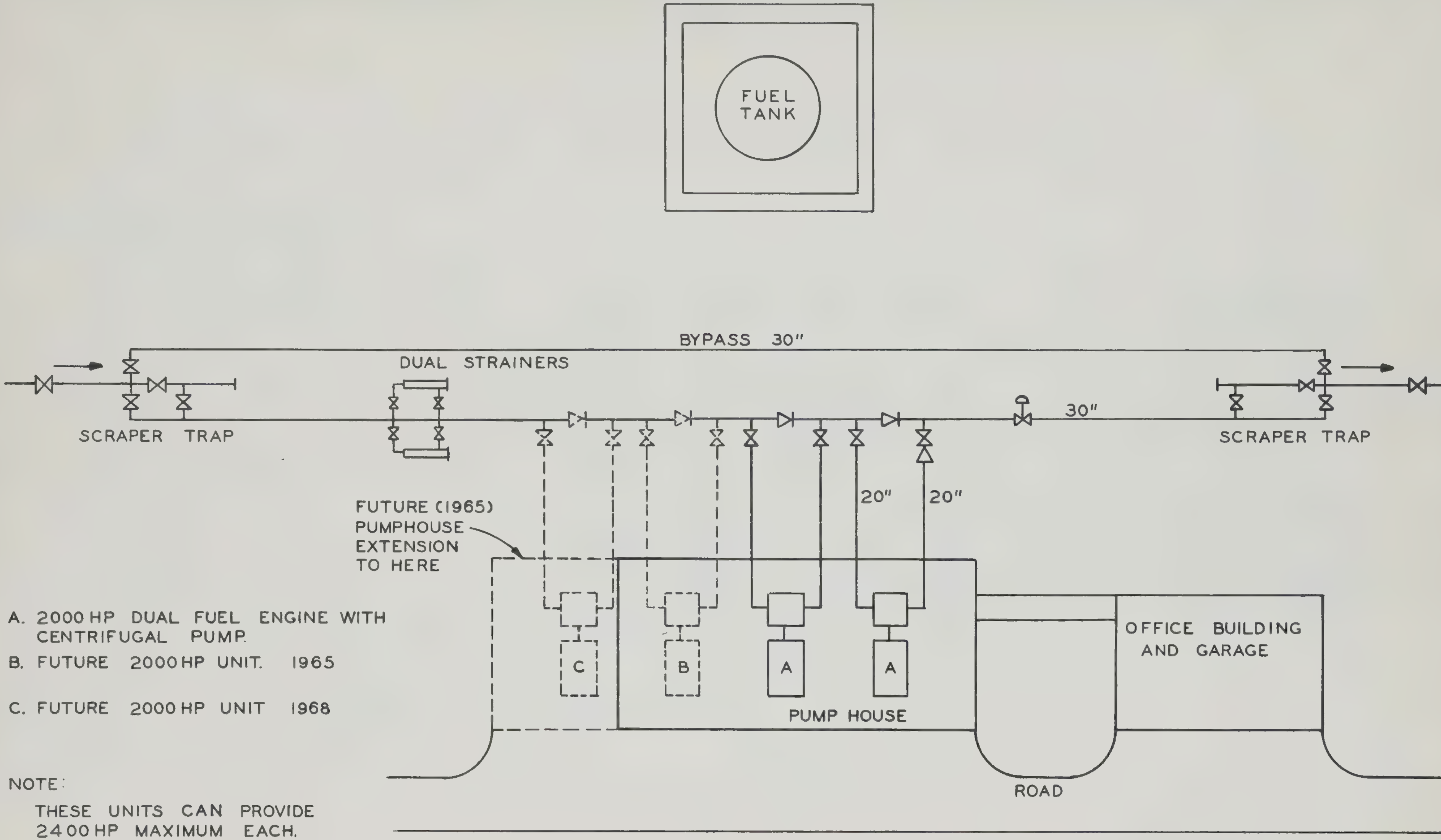


*A - 2000 H.P. DUAL FUEL ENGINE WITH CENTRIFUGAL PUMP
*B - FUTURE 2000 H.P. UNIT 1965
C - 100 H.P. BOOSTER PUMP, ELECTRIC DRIVE
D - STORAGE TANKS - CRUDE FROM BRITAMOIL JCT. & BELLSHILL LAKE FIELD; 150,000 BBL.; 150' x 48'
E - STORAGE TANKS - PEMBINA CRUDE; 150,000 BBL.; 150' x 48'
F - STORAGE TANKS - ALBERTA LIGHT CRUDE; 42,500 BBL.; 80' x 48'
G - STORAGE TANKS - REDWATER CRUDE; 96,000 BBL.; 120' x 48'
H - FUEL TANK
I - DUAL STRAINERS
*J - FUTURE 2000 H.P. UNIT 1968
K - 250 H.P. BOOSTER PUMP ELECTRIC DRIVE
L - FUTURE (1963) 100 H.P. BOOSTER PUMP

*NOTE - THESE UNITS CAN PROVIDE 2400 H.P. MAX. EACH

BELLSHILL LAKE STATION
SCHEMATIC LAYOUT
EXHIBIT 26

TMC



A. 2000 HP DUAL FUEL ENGINE WITH CENTRIFUGAL PUMP.

B. FUTURE 2000 HP UNIT. 1965

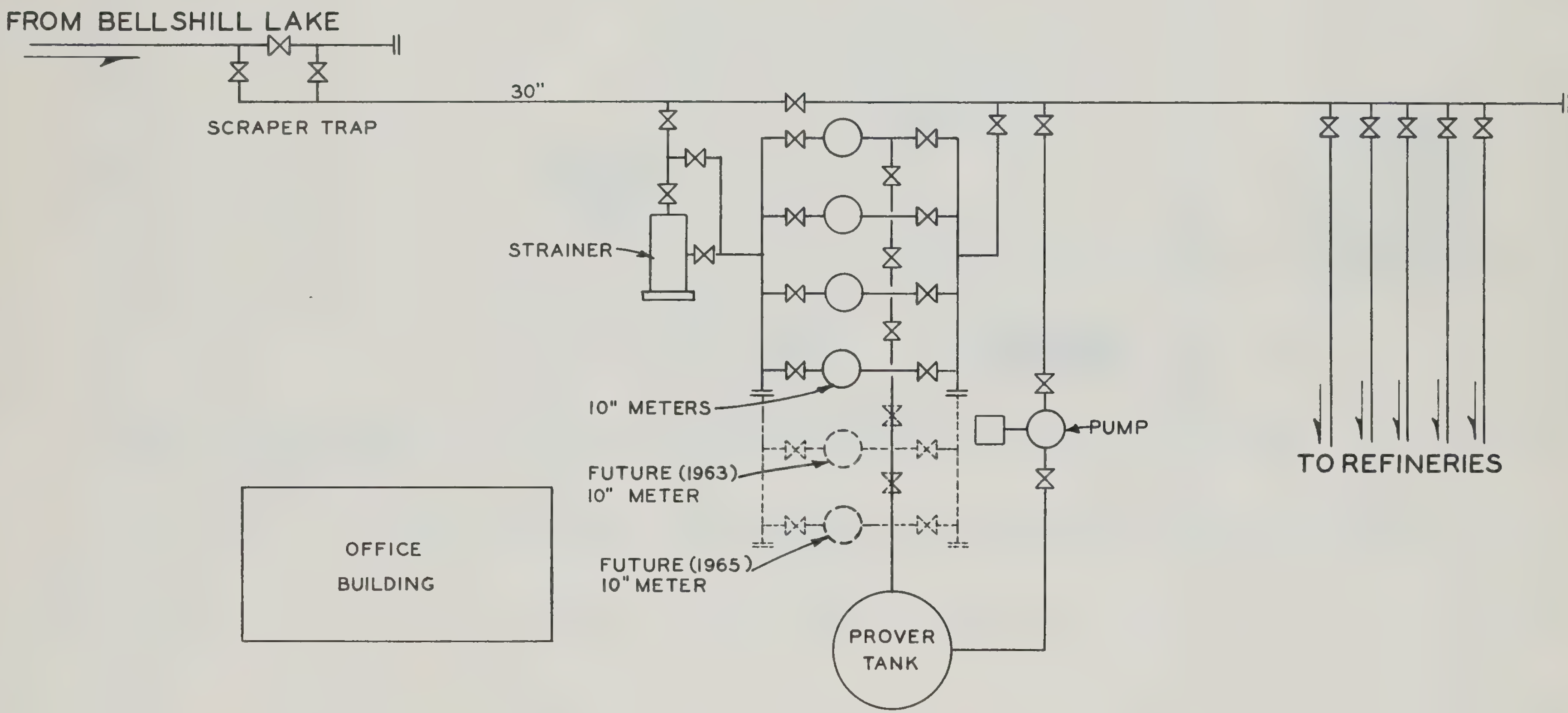
C. FUTURE 2000 HP UNIT 1968

NOTE:

THESE UNITS CAN PROVIDE 2400 HP MAXIMUM EACH.

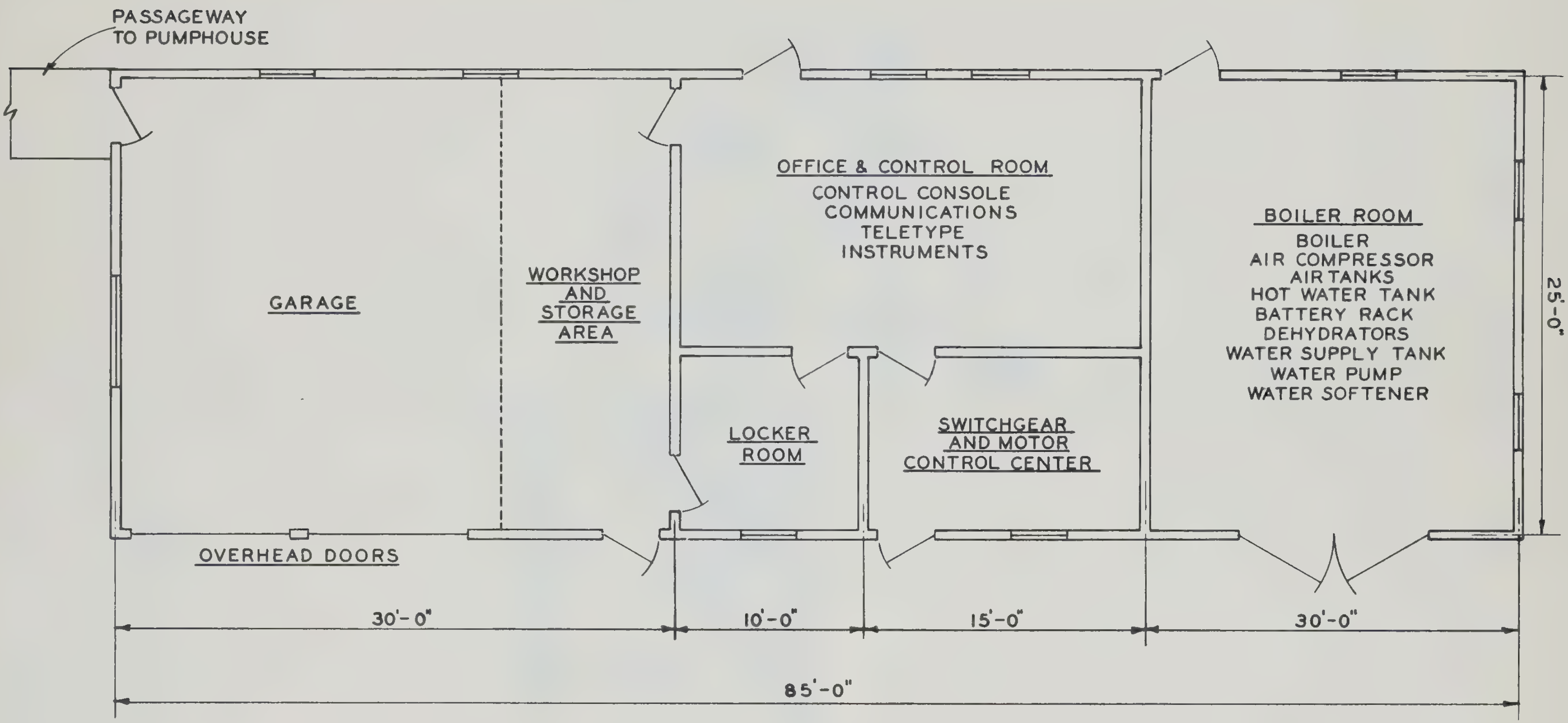
TYPICAL INTERMEDIATE STATION
SCHEMATIC LAYOUT

EXHIBIT 27



MONTREAL TERMINAL
SCHEMATIC LAYOUT

EXHIBIT 28



OFFICE BUILDING PLAN

EXHIBIT 29

MAIN LINE

STATION BUILDING PERSPECTIVE

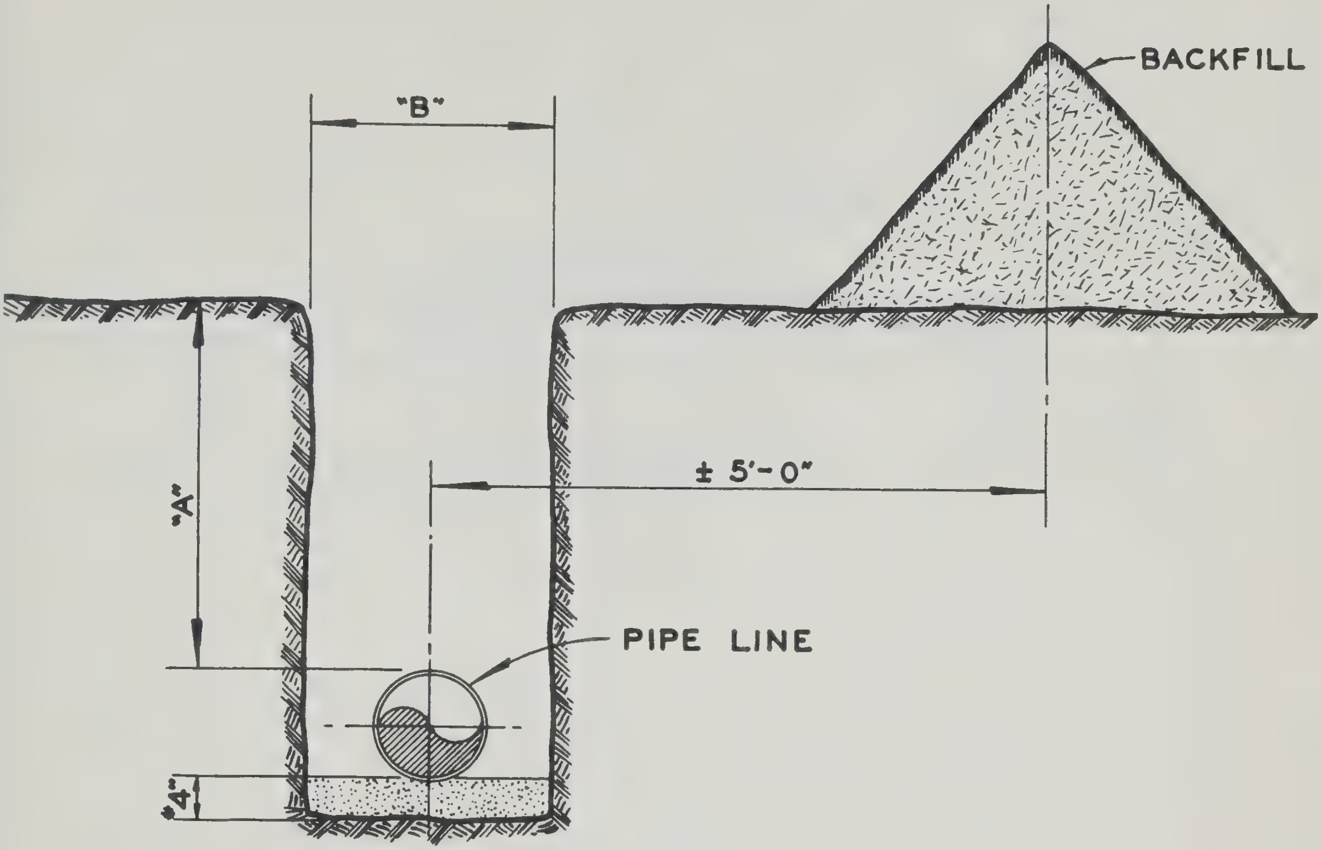
EXHIBIT 30

4. CONSTRUCTION EXHIBITS

Exhibits A through N on the following pages show proposed Main Line construction details. The titles of these exhibits are listed below. These exhibits are also presented in Volume II.

List of Construction Exhibits

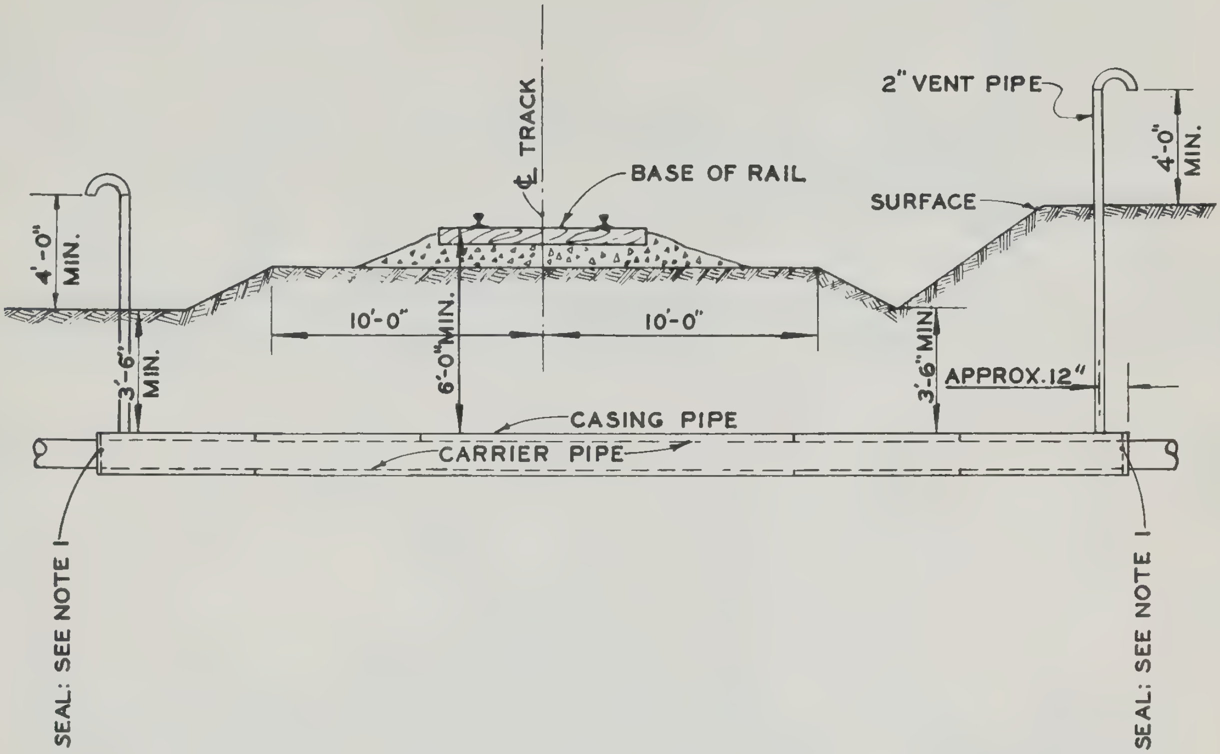
No.	Title
A.	Minimum Ditch Requirements
B.	Specifications for Railroad Crossings
C.	Specifications for Highway Crossings
D.	Specifications for River Crossings
E.	Specifications for Electrolysis Test Stations
F.	Specifications for Aerial Markers
G.	Highway and Railroad Pipeline Markers
H.	Schedule of Main Line Gate Valves
I.	Specifications for Anchor Rods
J.	Specifications for Tile Repair
K.	Casing End Closure "Z" Gasket Installation
L.	Main Line Gate Valve Installation
M.	Details of Gate Installations
N.	Specifications for Insulating Flanges



*4" LOOSE EARTH PADDING REQUIRED IN BOTTOM OF DITCH FOR ROCK EXCAVATION WHERE NECESSARY.

PIPE DIA.	MIN. DIM. "A" IN EARTH	MIN. DIM. "A" IN ROCK	MIN. DIM. "B" EARTH OR ROCK
10"	36"	20"	20"
16"	36"	20"	26"
26"	36"	20"	36"
30"	36"	20"	40"

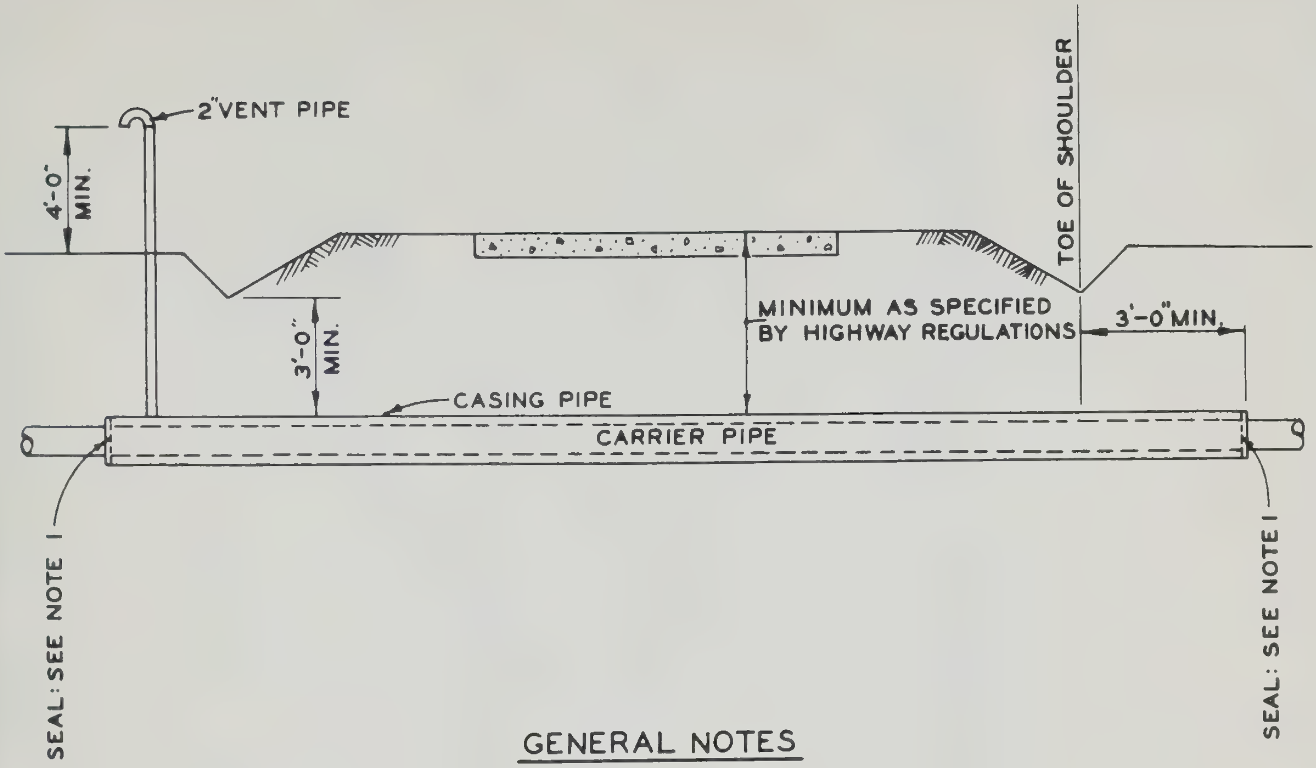
DUTTON-WILLIAMS BROTHERS LIMITED ENGINEERS — CONSTRUCTORS CALGARY, ALBERTA		MINIMUM DITCH REQUIREMENTS	
DRAWN H.T.W.	DATE 2-8-58	CHECKED C.J.F.	EXHIBIT A
TRACED H.T.W.	SCALE NONE	APPROVED W.N.G.	



GENERAL NOTES

1. SEAL CASING BUSHING, WILLIAMSON TYPE Z, EACH END.
2. PIPELINE SHALL NOT BE CONSTRUCTED UNDER RAILROAD RIGHT OF WAY AND TRACKS NEARER THAN SIX (6) FEET ON A LINE PERPENDICULARLY DISTANT FROM ANY RAIL JOINT IN SAID TRACK.
3. CASING PIPE SHALL BE PLACED UNDER ROADBED AND TRACKS BY THE JACKING OR BORING METHOD IN ALL CROSSINGS UNDER THIS PARTICULAR SPECIFICATION UNLESS INSTRUCTIONS TO THE CONTRARY ARE ISSUED BY THE COMPANY. THE TRENCH ON EACH SIDE OF THE TRACK SHALL BE PROMPTLY REFILLED IN A PROPER AND WORKMANLIKE MANNER. SO AS TO LEAVE NO HOLES OR OBSTRUCTIONS THEREIN AND SO AS TO FURNISH AND PROVIDE PROPER DRAINAGE.
4. WHERE, IN THE OPINION OF THE RAILROAD COMPANY'S CHIEF ENGINEER, DRAINAGE DITCHES OR OTHER CONDITIONS REQUIRE THE PIPE AND CASING TO BE BURIED TO A GREATER DEPTH, PIPE SHALL BE SO INSTALLED.
5. NO PIPE SHALL BE PLACED ON, UNDER, OR WITHIN 25 FEET OF, ANY BRIDGE, CULVERT, OR STRUCTURE, WITHOUT SPECIAL AUTHORITY OF RAILROAD COMPANY'S CHIEF ENGINEER.
6. CASING PIPE SHALL BE $\frac{3}{8}$" WALL WITH AN OUTSIDE DIAMETER 4" GREATER THAN THAT OF THE MAIN LINE PIPE.
7. IN ALL CASES THE SPECIFICATIONS OF THE OF THE RAILROAD COMPANY WHOSE FACILITIES ARE BEING CROSSED SHALL GOVERN.

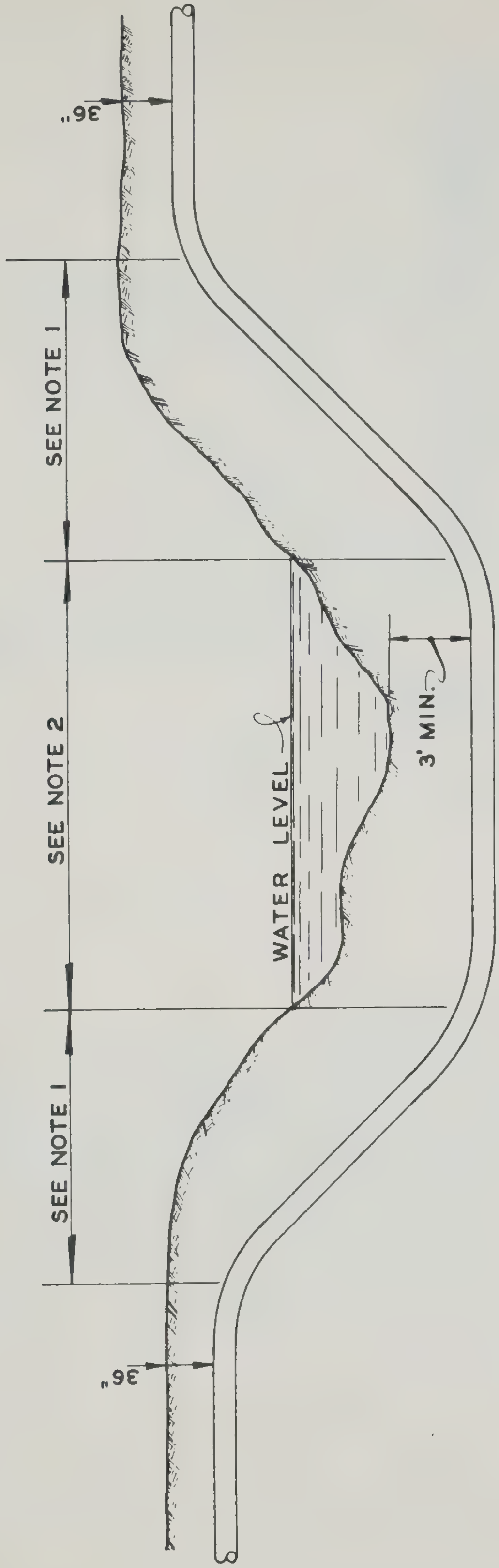
DUTTON-WILLIAMS BROTHERS LIMITED ENGINEERS — CONSTRUCTORS CALGARY, ALBERTA		SPECIFICATIONS FOR RAILROAD CROSSINGS	
DRAWN ROGERS	DATE 2-1-58	CHECKED C. B. D.	EXHIBIT B
TRACED	SCALE NONE	APPROVED C. J. F.	



GENERAL NOTES

1. SEAL CASING BUSHING, WILLIAMSON TYPE Z, EACH END.
2. BORING SHALL BE DONE BY AN APPROVED METHOD AND THE CASING SHALL BE ADVANCED AT A RATE APPROXIMATELY EQUAL TO THE RATE OF BORING. WHERE BORING IS NOT PRACTICAL, DUE TO ROCK STRATA OR OTHER OBSTRUCTIONS, THE CHIEF ENGINEER OF THE DEPARTMENT OF HIGHWAYS SHALL FIRST APPROVE ALL PLANS FOR CONSTRUCTION BY "OPEN CUT", "TUNNELING", OR OTHER METHODS.
3. IN REFILLING THE TRENCH EXCAVATED FOR THE PIPELINE, ADJACENT TO HARD SURFACED ROADS OR HIGHWAYS AND ACROSS ROADS WHERE TRENCHING IS PERMITTED, THE TRENCH SHALL BE PROMPTLY BACKFILLED IN A PROPER AND WORKMANLIKE MANNER SO AS TO LEAVE NO HOLES OR OBSTRUCTIONS THEREIN AND SO AS TO FURNISH AND PROVIDE PROPER DRAINAGE.
4. CASING PIPE SHALL BE $\frac{3}{8}$" WALL WITH AN OUTSIDE DIAMETER 4" GREATER THAN THAT OF THE MAIN LINE PIPE.
5. LOCATE VENT ACCORDING TO HIGHWAY DEPT. INSTRUCTIONS.

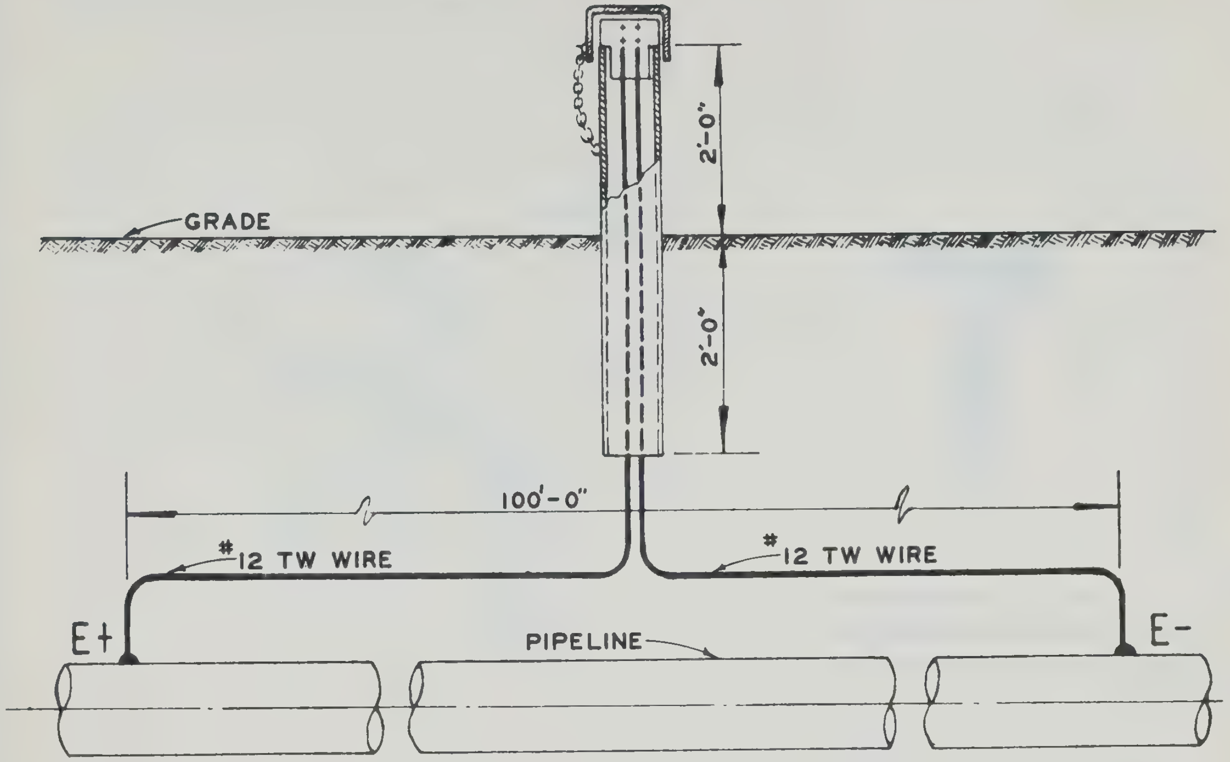
DUTTON-WILLIAMS BROTHERS LIMITED ENGINEERS — CONSTRUCTORS CALGARY, ALBERTA		SPECIFICATIONS FOR HIGHWAY CROSSINGS	
DRAWN ROGERS	DATE 2-1-58	CHECKED C. B. D.	EXHIBIT C
TRACED	SCALE NONE	APPROVED C. J. F.	



NOTES:

1. PIPE TO BE LAID TO EXTRA DEPTH AT THESE LOCATIONS TO PREVENT EXCESSIVE BENDING.
2. RIVER PIPE TO BE LEVEL UNDER RIVER CHANNEL EXCEPT IN ROCK FORMATIONS WHERE PIPE MAY BE LAID A MINIMUM OF 3' BELOW RIVER BED.

DUTTON-WILLIAMS BROTHERS LIMITED ENGINEERS — CONSTRUCTORS CALGARY, ALBERTA		SPECIFICATIONS FOR RIVER CROSSINGS	
DRAWN ROGERS	DATE 2-1-58	CHECKED C.B.D.	EXHIBIT D
TRACED	SCALE NONE	APPROVED C.J.F.	

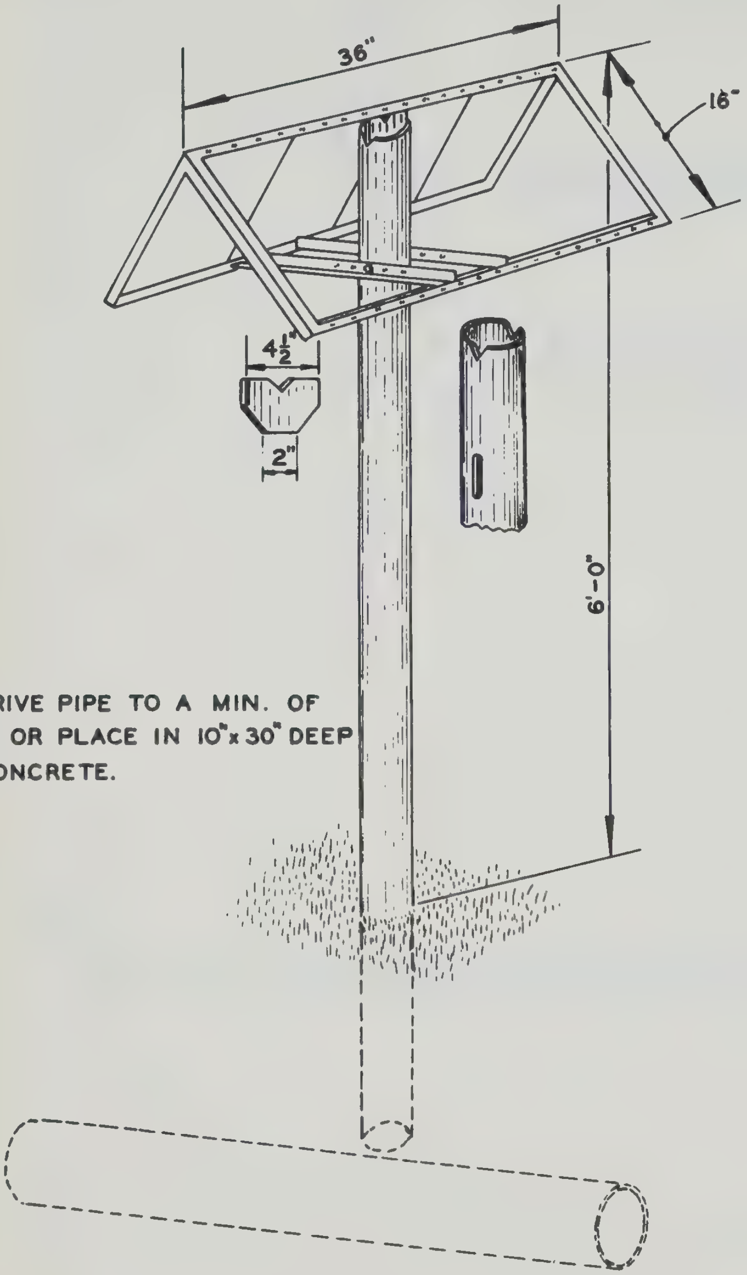


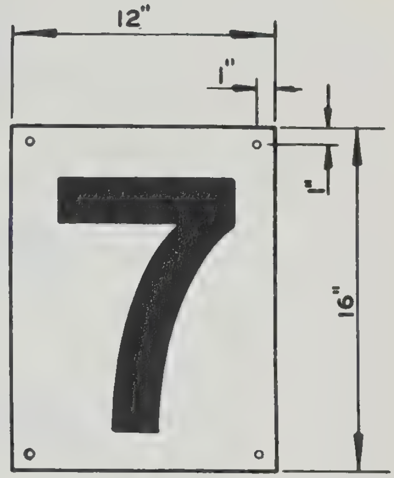
GENERAL NOTES

1. STD. WT. 2" PIPE BURIED 2' IN GROUND AND 2' ABOVE GROUND. WIRES TIED TO SERVICE ENGINEERS INC. 2 SIZE PLASTIC TERMINAL BOARD AND PIPE CAPPED WITH 2" SIZE SERVICE ENGINEERS INC. ELECTROLYSIS CHECK POINT ALUMINUM CAP WITH CHAIN SPOT WELDED OR BRAZED TO THE 2" PIPE 8" BELOW TOP OF PIPE.
2. WIRES TO BE SOLID TW COVERED #12 COPPER WIRE FURNISHED BY THE COMPANY.
3. WIRES TO BE WELDED TO PIPE BY THE CADWELD PROCESS AND INSULATED WITH ENAMEL AND ASBESTOS FELT PAPER OR ADHESIVE TAPE. MATERIAL TO BE FURNISHED BY THE COMPANY.
4. LAY WIRES IN TRENCH BESIDE PIPE, NOT UNDER OR OVER PIPE.

DUTTON-WILLIAMS BROTHERS LIMITED ENGINEERS — CONSTRUCTORS CALGARY, ALBERTA		SPECIFICATIONS FOR ELECTROLYSIS TEST STATIONS	
DRAWN ROGERS	DATE 2-1-58	CHECKED C. B. D.	EXHIBIT E
TRACED	SCALE NONE	APPROVED C. J. F.	

MARKER TO BE MOUNTED ON 4" PIPE.
WEDGE USED TO ATTACH TOP MEMBER.
BOLT USED TO ATTACH BOTTOM MEMBER.
ALL FRAME TO BE 1" x 1" x $\frac{3}{16}$" ANGLE.





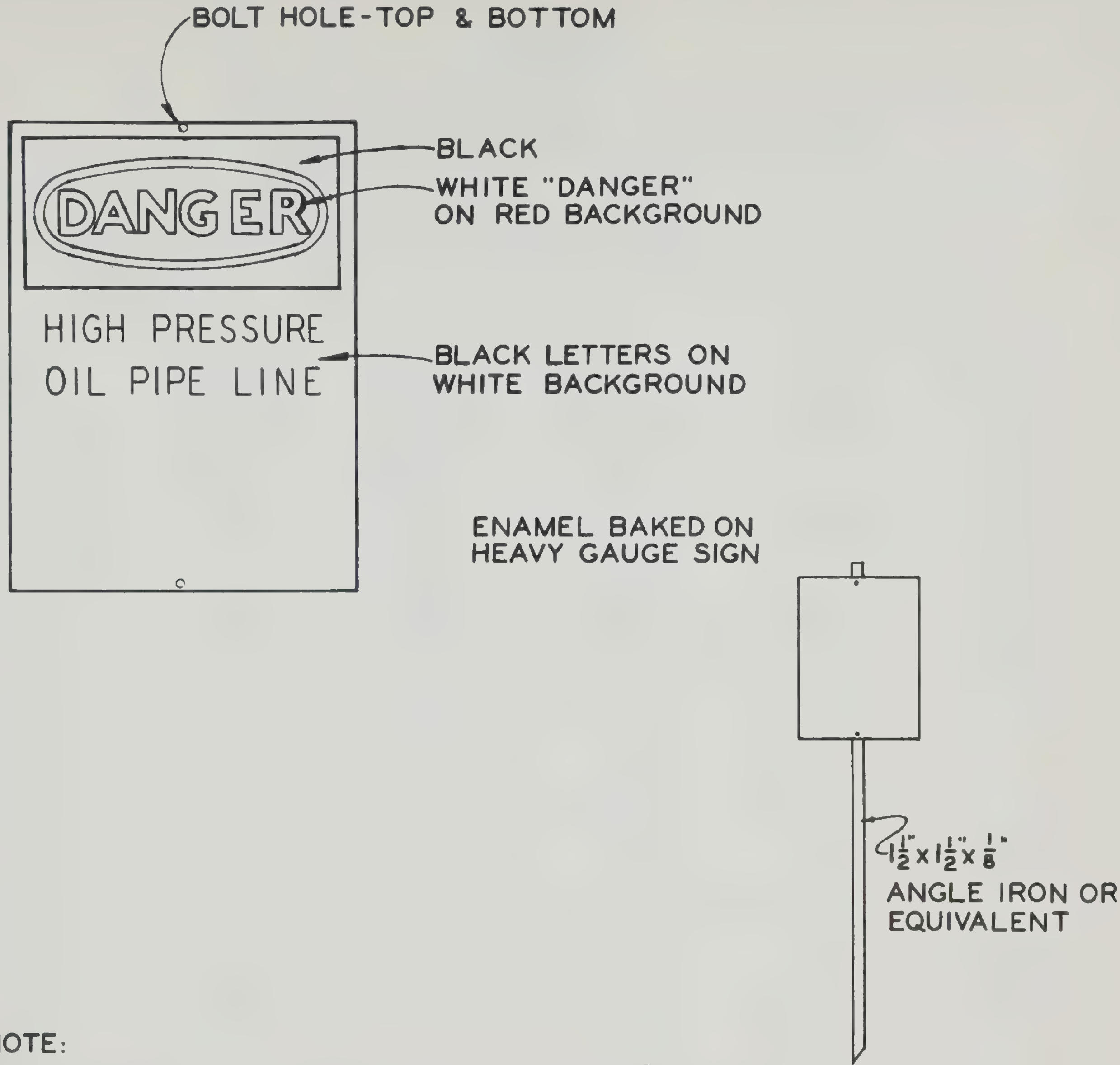
BACKGROUND COLOR TO BE BRIGHT ORANGE OR CHROME YELLOW.
ALL NUMERALS TO BE DEAD BLACK.

ATTACH NUMERALS TO ARMS WITH $\frac{1}{8}$" ϕ BOLTS.

NUMERAL PLATES TO HAVE PORCELAIN FINISH. ALL OTHER METAL TO HAVE PROTECTIVE ALUMINUM COATING.

DRIVE PIPE TO A MIN. OF 4' OR PLACE IN 10" x 30" DEEP CONCRETE.

DUTTON-WILLIAMS BROTHERS LIMITED ENGINEERS — CONSTRUCTORS CALGARY, ALBERTA		SPECIFICATIONS FOR AERIAL MARKERS	
DRAWN ROGERS	DATE 2-1-58	CHECKED C. B. D.	EXHIBIT F
TRACED	SCALE NONE	APPROVED C. J. F.	



NOTE:

TO BE PLACED OVER THE PIPELINE ON EACH BOUNDARY OF EACH HIGHWAY, PUBLIC ROAD, OR RAILROAD RIGHT OF WAY.

DUTTON-WILLIAMS BROTHERS LIMITED ENGINEERS — CONSTRUCTORS CALGARY, ALBERTA		HIGHWAY AND RAILROAD PIPELINE MARKERS	
DRAWN ROGERS	DATE 2-1-58	CHECKED C. B. D.	EXHIBIT G
TRACED	SCALE NONE	APPROVED C. J. F.	

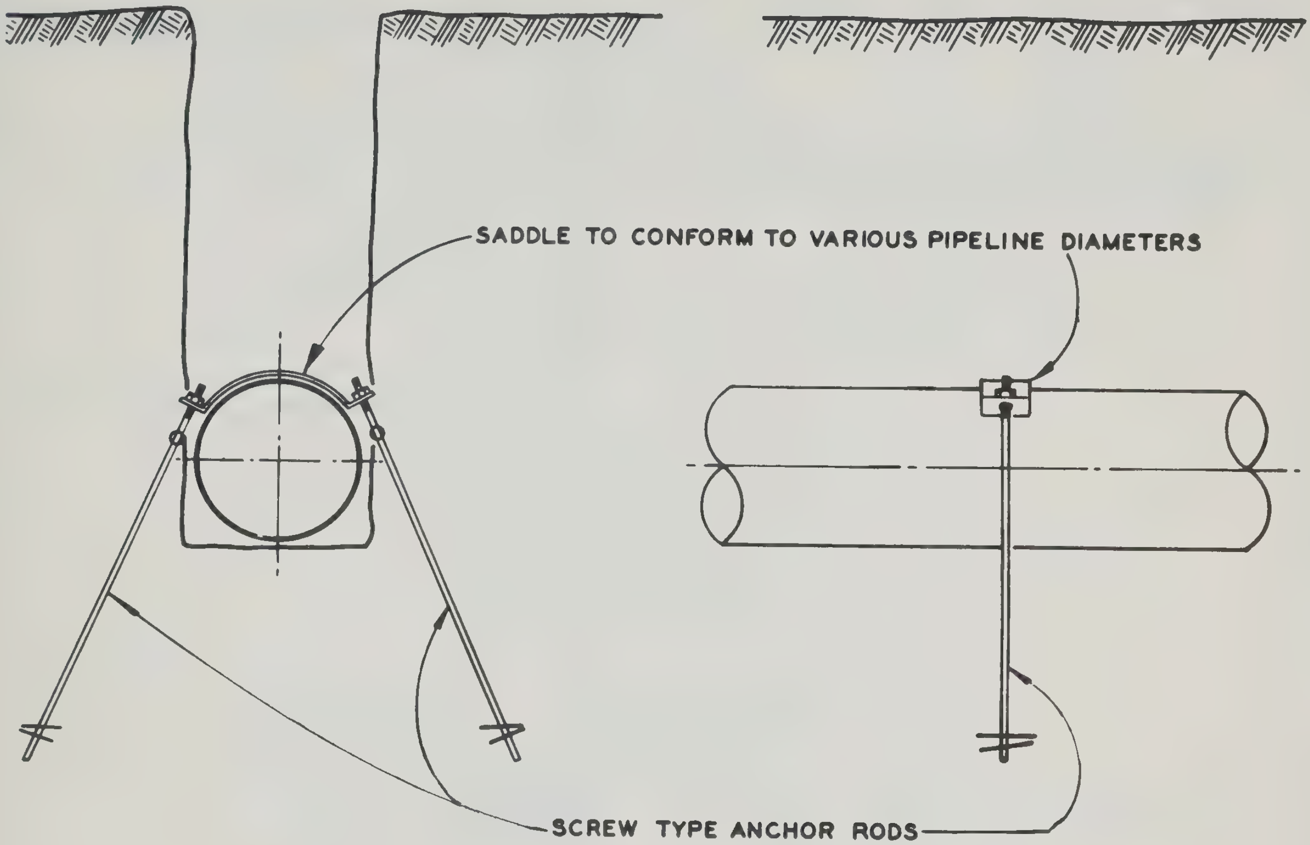
EXHIBIT H

SCHEDULE OF MAIN LINE GATE VALVES

Location - Milepost Measured from Edmonton

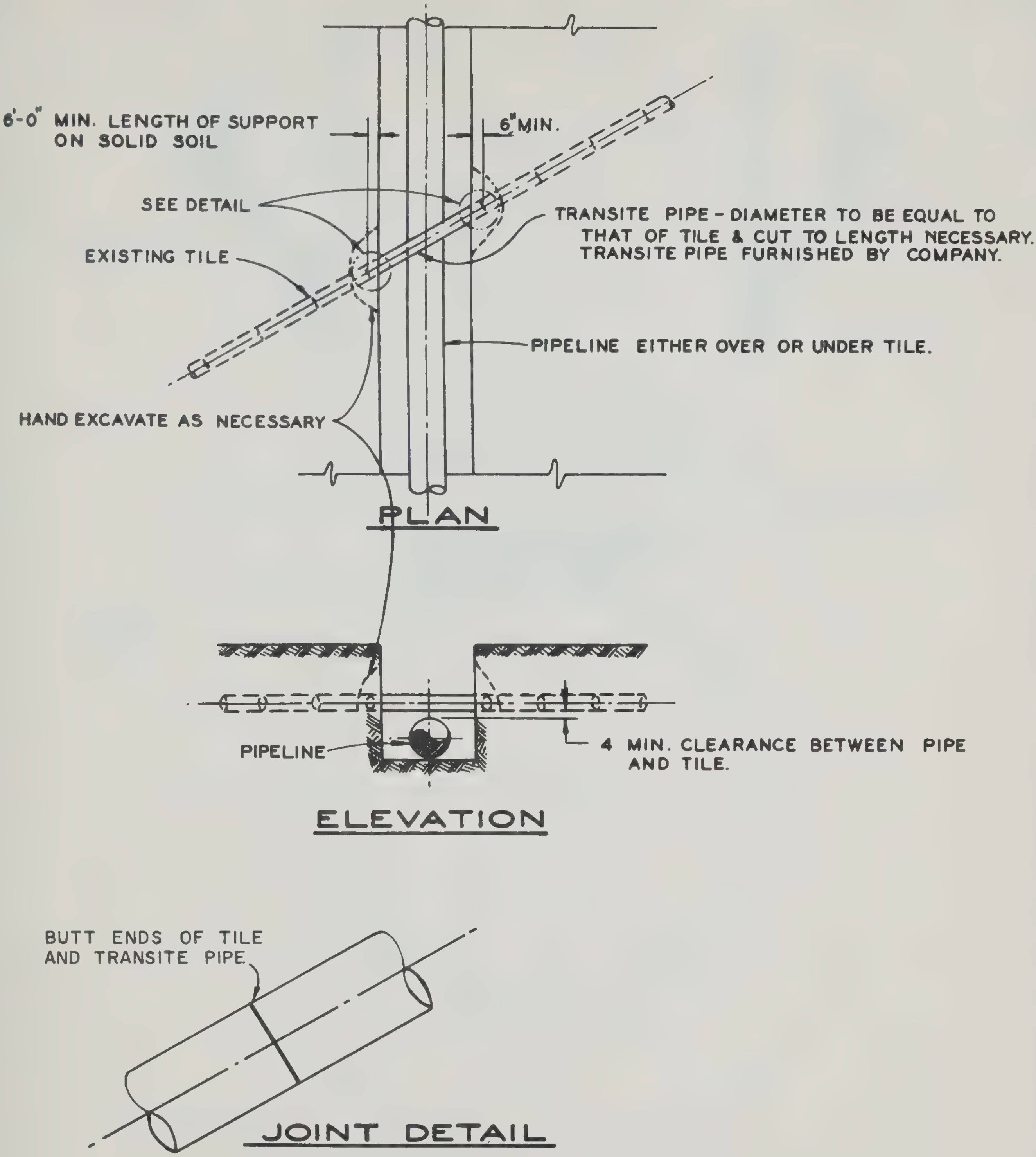
Southern Route			Northern Route		
124.3	745.0	1380.0	124.3	825.0	1460.0
150.2	766.8	1424.0	150.2	872.0	1460.5
176.7	810.0	1440.0	176.7	897.0	1479.0
193.9	834.0	1489.6	193.9	920.0	1498.0
241.2	878.0	1508.6	241.2	970.0	1523.0
267.5	900.0	1549.4	267.5	995.0	1523.5
293.7	923.0	1569.2	293.7	1019.0	1550.0
329.0	964.0	1589.3	336.0	1019.5	1577.0
370.5	984.0	1609.2	370.5	1070.0	1627.0
391.0	1003.8	1652.0	391.0	1095.0	1651.0
411.6	1024.5	1675.0	411.6	1120.0	1675.0
452.5	1068.2	1699.6	428.0	1145.0	1721.0
471.3	1091.9	1721.7	472.0	1195.0	1744.0
490.0	1112.3	1770.5	498.0	1220.0	1792.0
511.7	1137.5	1794.8	523.0	1247.0	1816.0
553.2	1180.5	1839.4	582.0	1297.0	1866.0
577.7	1203.0	1862.4	613.0	1323.0	1891.0
600.2	1223.9	1909.5	673.0	1347.0	1915.0
638.5	1267.3	1931.2	711.0	1373.0	1960.0
661.0	1290.0	1954.0	775.0	1419.0	1983.0
684.0	1310.4	1998.8	775.5	1419.5	2000.0
727.8	1355.5		800.0	1439.0	2000.5
TOTAL: 65 Gate Valves, Main Line			TOTAL: 66 Gate Valves, Main Line		

Calgary Lateral (MP measured from Calgary)		Edmonton Lateral (26" O. D. Pipe) (MP measured from Edmonton)
for 10 3/4" O. D. Pipe	for 16" O. D. Pipe	
14.5	93.2	21.2
31.4	114.8	41.9
43.0		65.5
59.5		82.3

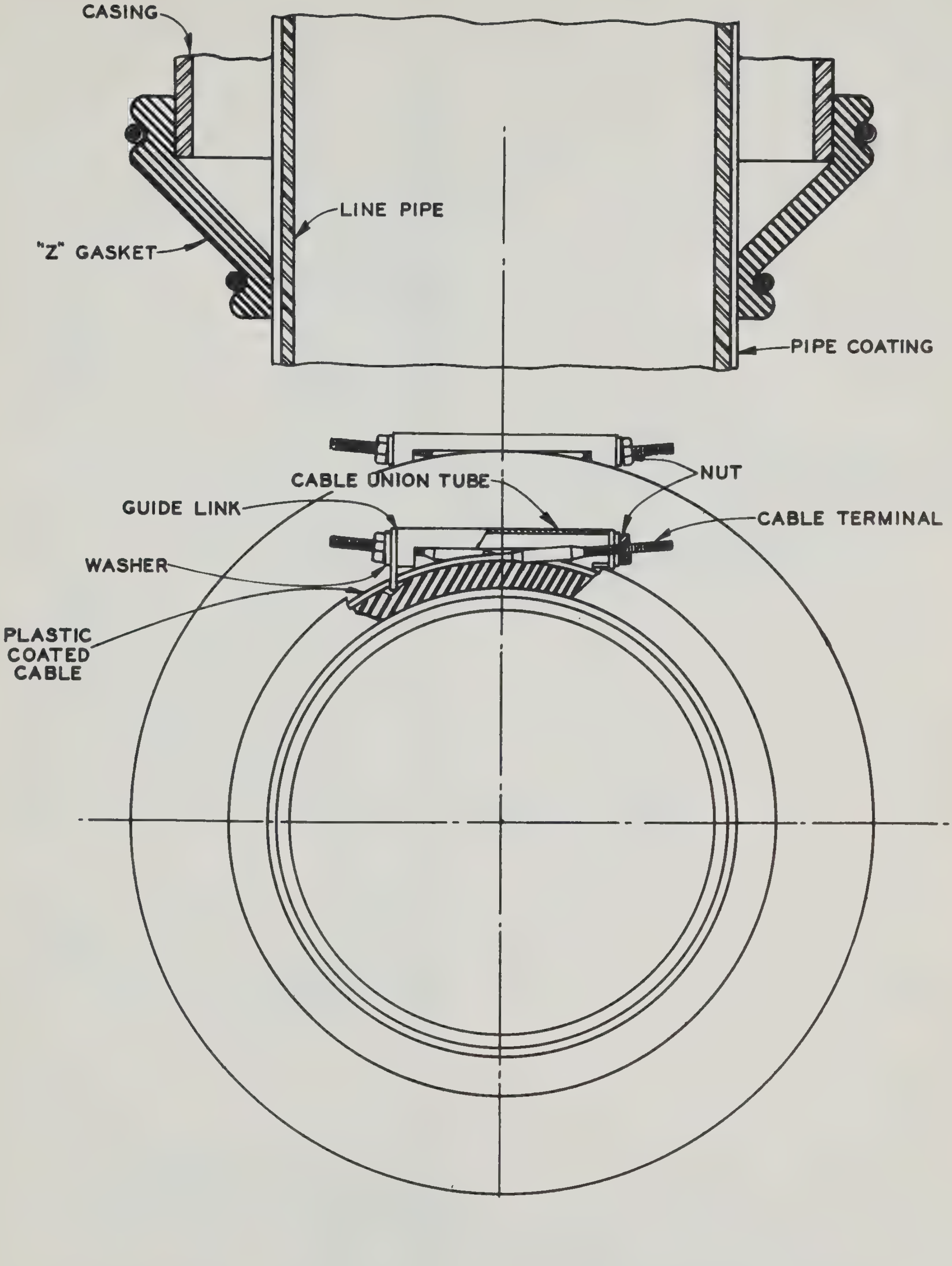


NOTE: LOCATION AND SPACING TO BE DETERMINED BY FIELD ENGINEER.
TO BE INSTALLED IN AREAS SUBJECT TO POSSIBLE INUNDATION PRIOR TO CONSOLIDATION OF THE BACKFILL.

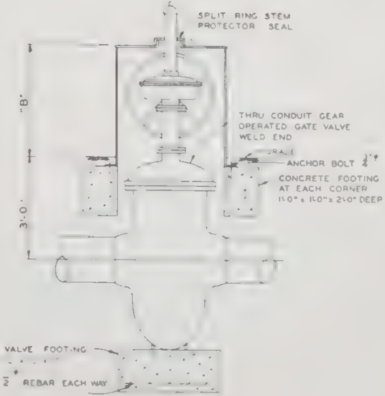
DUTTON-WILLIAMS BROTHERS LIMITED ENGINEERS — CONSTRUCTORS CALGARY, ALBERTA		SPECIFICATIONS FOR ANCHOR RODS	
DRAWN ROGERS	DATE 2-1-58	CHECKED C. B. D.	EXHIBIT I
TRACED	SCALE NONE	APPROVED C. J. F.	

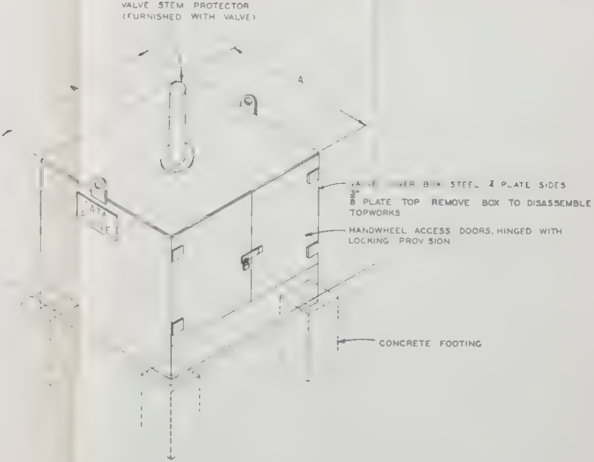


DUTTON - WILLIAMS BROTHERS LIMITED ENGINEERS — CONSTRUCTORS CALGARY, ALBERTA		SPECIFICATIONS FOR TILE REPAIR	
DRAWN ROGERS	DATE 2-1-58	CHECKED C. B. D.	EXHIBIT J
TRACED	SCALE NONE	APPROVED C. J. F.	



DUTTON-WILLIAMS BROTHERS LIMITED ENGINEERS — CONSTRUCTORS CALGARY, ALBERTA		CASING END CLOSURE "Z" GASKET INSTALLATION	
DRAWN ROGERS	DATE 2-1-58	CHECKED C.B.D.	EXHIBIT K
TRACED	SCALE NONE	APPROVED C.J.F.	

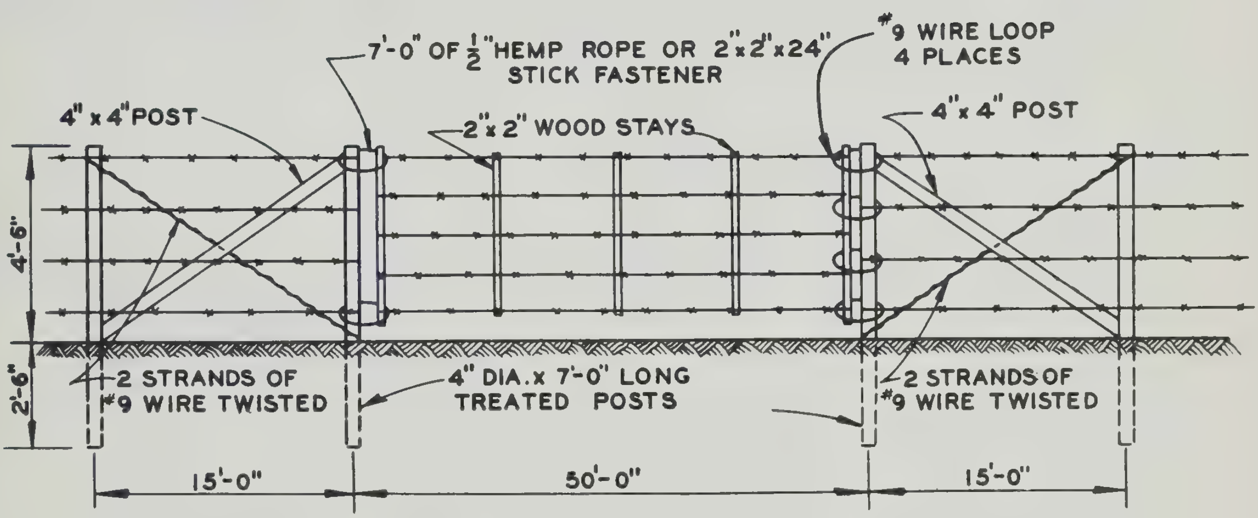




VALVE SIZE	A	B	C	D
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	38	[illegible]	36	[illegible]
26	50	69	46	8
30	56	[illegible]	5	[illegible]

WILLIAMS BROTHERS COMPANY ENGINEERS — CONSTRUCTORS NEW YORK TULSA HOUSTON ATLANTA	MAIN LINE GATE VALVE INSTALLATION
DRAWN ZEVNIK DATE 2-6-58 TRACED SCALE NONE	C B D APPROVED C. J. F. EXHIBIT L

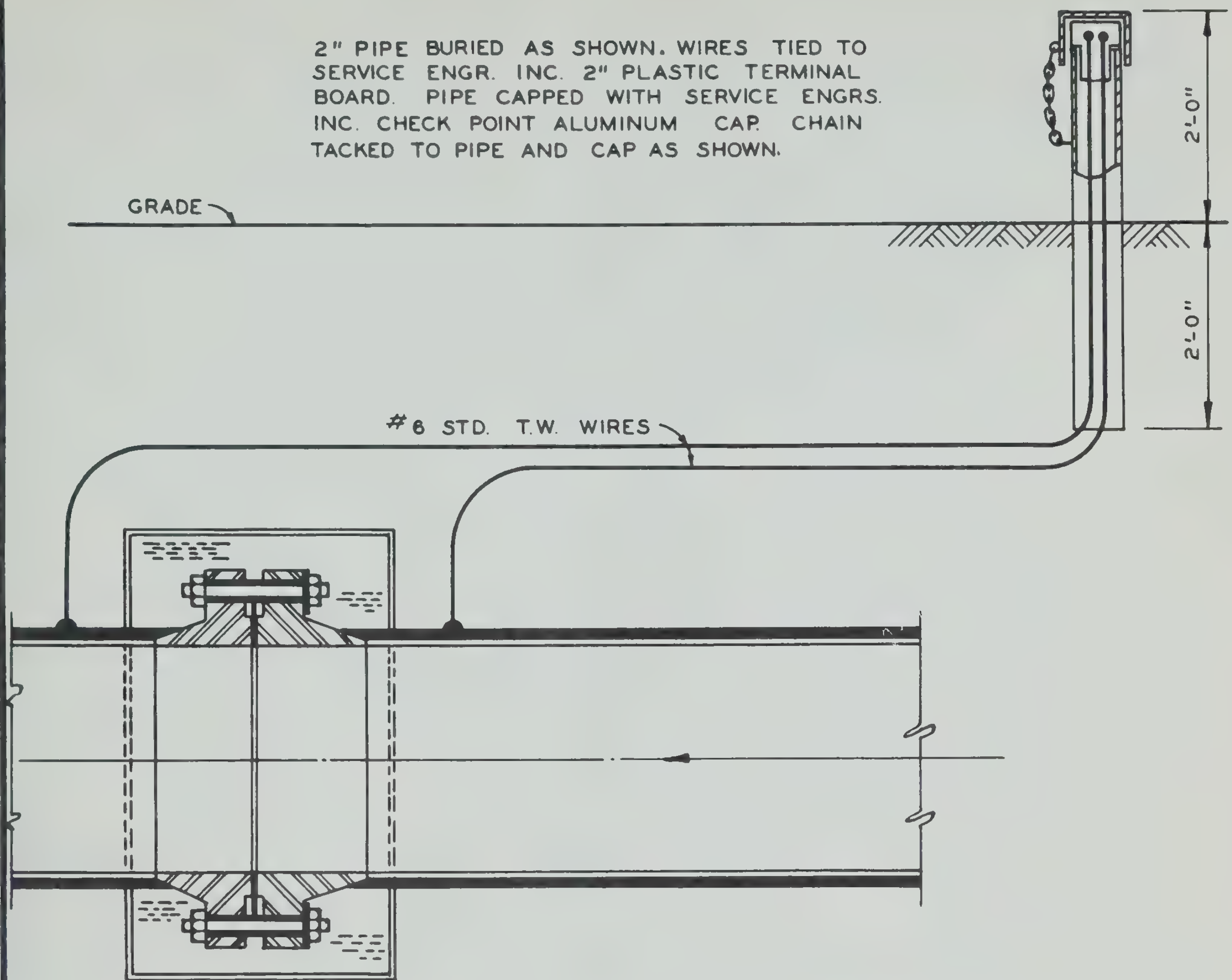
OFFSET METHOD
TO BE USED AT CUTS



GATE INSTALLATION

NOTE: REBUILD FENCES TO ORIGINAL POST SPACING REMOVING ALL BRACES AND TIES.

DUTTON - WILLIAMS BROTHERS LIMITED ENGINEERS — CONSTRUCTORS CALGARY, ALBERTA		DETAILS OF GATE INSTALLATIONS	
DRAWN ROGERS	DATE 2 - 1 - 58	CHECKED C.B.D.	EXHIBIT M
TRACED	SCALE NONE	APPROVED C.J.F.	



INSULATING FLANGE BOXED AND FILLED WITH PIPE LINE ENAMEL OR WAX TO COVER COMPLETELY, AFTER LINE HAS BEEN HYDROSTATICALLY TESTED.

ABOVE GROUND INSULATED FLANGES NEED NOT BE ENCASED.

COPPER WIRE CONNECTIONS TO PIPE SHALL BE THERMITE WELDED. PIPE COATING MUST BE REPAIRED AFTER WELD IS MADE.

INSULATING FLANGES ADJACENT TO VALVES NEED NOT BE ENCASED NOR WILL TEST LEADS BE REQUIRED.

LOCATIONS DEPENDENT UPON SOIL CONDITION DETERMINED PRIOR TO CONSTRUCTION.

DUTTON-WILLIAMS BROTHERS LIMITED ENGINEERS — CONSTRUCTORS CALGARY, ALBERTA		SPECIFICATIONS FOR INSULATING FLANGES	
DRAWN ZEVNIK	DATE 2-1-58	CHECKED C. B. D.	EXHIBIT N
TRACED	SCALE NONE	APPROVED C. J. F.	

CHAPTER II

ECONOMIC STUDIES

A. ESTIMATED INVESTMENT REQUIREMENTS

1. SUMMARY

Capital requirements are summarized on the following page, and presented in detail on succeeding pages. Investment costs were derived from an analysis of preliminary design drawings for the pumping stations and terminal facilities, field investigation of the pipeline traverse, and detailed cost comparison of pipe prices delivered along the traverse from quotations by pipe manufacturers. Other capital requirements were developed from empirical data for this particular project. Such items as financing cost, working capital and interest during construction are derived under Section C, Financial Data.

The capital requirements as summarized serve as aids in financing and in calculation of operating costs and revenue requirements. Two systems are shown, the 30-inch systems for both the Southern Route and Northern Route. Costs were prepared in detail for both Routes. A buildup of costs for each of the ten years as stations and other facilities are added periodically is shown in the details and under Financial Data. Only the first and tenth year figures are shown on the following page to maintain conciseness in the summary.

SUMMARY OF ESTIMATED CAPITAL REQUIREMENTS

(000 Omitted)

	Southern Route 30-Inch System		Northern Route 30-Inch System	
	1960	1969	1960	1969
1. Pipelines	$286,472	$286,472	$320,454	$320,454
2. Stations and Terminals	20,990	45,628	21,802	47,325
Total System Cost	$307,462	$332,100	$342,256	$367,779
3. Interest During Construction	$ 12,107	$ 12,629	$ 13,476	$ 14,018
4. Working Capital	1,884	1,884	1,929	1,929
5. Financing Costs	7,776	7,776	8,438	8,438
6. Line Fill	24,089	24,089	23,922	23,922
Total Capital Requirement	$353,318	$378,478	$390,021	$416,086

2. BASIS OF COSTS

Costs detailed on the following pages are based on these conditions:

a. It is assumed that the construction period would be from July 1, 1958 to December, 1959. Throughput would begin on January 1, 1960.

b. All costs are based on a rate of exchange of one Canadian dollar equals one United States dollar. Under present trends it would appear advantageous to purchase imports as soon as possible.

c. All costs are based on present prices except for pipe. Pipe costs have been increased seven dollars per ton over present prices in anticipation of such approximate increase effective July 1. If pipe costs are further increased in 1959, such increase must be covered by the five percent contingency factor added to pipeline costs. In addition, if the duty on imported skelp is raised from five percent to ten percent, Canadian pipe costs will increase an estimated three to four percent. No allowance has been made for this possibility.

d. Present indications from pipe manufacturers are that if pipe orders were placed by May 1, 1958, deliveries could start by July 1 on 26-inch and larger pipe, and immediately for the 16-inch and smaller sizes.

e. Canadian mills can roll 100 miles per month of 30-inch pipe. U.S. mills can presently guarantee full delivery within the construction period. However, it is urgent that commitments for pipe be made as soon as possible to insure delivery as required.

f. A Canadian duty of 22-1/2 percent has been assumed for pipe 10-3/4-inch OD and less, and for valves and pipeline accessories necessarily imported from the United States. A duty of 15 percent has been assumed on imported pipe larger than 10-3/4-inch OD. No allowance has been made for the fact that such duty may be increased to 22 1/2 percent before all pipe is purchased. All material prices include Dominion sales tax of 10%, and provincial and state sales tax where applicable as follows: Saskatchewan, 3%; North Dakota, 2%; Michigan, 3%; and Quebec, 2%.

g. After inclusion of Canadian duty, U.S. pipe is slightly more expensive than Canadian pipe. Canadian pipe would thus be used where possible. However, considering the possibility that present delivery promises may change by the time firm

orders are placed, pipe has been assumed originating from the following sources for the various alternates:

		Southern Route		Northern Route
Source	Smaller Pipe	Canadian Part 30"	U.S. Part 30"	30"
Canada	100%	50%		62.5%
U.S.A.		50%	100%	37.5%

h. No drawback of Canadian duty or Dominion sales tax has been considered.

i. Communications facilities are assumed leased wire and therefore are shown as operating rather than investment costs.

j. All pumps in pump stations are assumed powered by engines using crude oil from the pipeline for fuel.

k. A factor for contingencies and omissions is included in investment costs as five percent for the pipeline system and ten percent for pump stations and terminals.

l. Engineering-management costs of seven percent as shown include (1) preparation of detailed engineering design, specifications, bills of material, and contract documents; (2) field survey, including staking right-of-way, preparation of plans and profiles, and inventory survey and maps; (3) right-of-way acquisition, including negotiations with owners but not including payments to owners; (4) negotiations of damage claims, but not including damage payments; (5) material procurement, expediting and shipping, including solicitation of competitive quotations, mill inspection of pipe, routing, receiving reports, and filing loss and damage claims with carrier and insurance companies; (6) construction inspection, including customary radiographic or X-ray welding inspection, and visual inspection of plant work, right-of-way, grade and alignment, ditch, welding, bending, coating, backfill and cleanup; (7) field engineering and administration of construction, including progress reports, automotive and field office expense, cost accounting, as-built drawings and supervision of testing the completed system.

m. Some detailed costs are shown only in summary for the sake of conciseness in report presentation. Details are available upon request to substantiate the items shown.

3. ANALYSIS OF PIPE REQUIREMENTS, SOUTHERN ROUTE

	OD	Wall	Miles	Tons
Alberta:	10 3/4"	1/4	73.5	5,441.2
	16"	1/4	71.5	7,937.2
	26"	13/32	6.65	1,949.6
		3/8	7.85	2,126.9
		11/32	9.5	2,362.3
		5/16	76.0	17,201.6
	30"	13/32	9.6	3,254.2
		3/8	34.1	10,681.5
		11/32	20.1	5,777.5
		5/16	12.9	3,374.3
Sub-Total			321.70	60,106.3
Saskatchewan:	24"	1/2	1.52	503.6
	30"	13/32	85.2	28,881.1
		3/8	82.2	25,748.3
		11/32	47.0	13,509.7
		5/16	198.2	51,843.2
Sub-Total			413.3	120,485.6
Manitoba:	30"	13/32	34.1	11,559.2
		3/8	14.5	4,542.0
		11/32	10.8	3,104.4
		5/16	54.1	14,150.9
Sub-Total			113.5	33,356.5
North Dakota:	30"	13/32	11.0	3,727.9
		3/8	10.5	3,289.0
		11/32	11.5	3,305.6
		5/16	72.5	18,963.8
			105.5	29,286.3

	OD	Wall	Miles	Tons
Minnesota:	30"	7/16	6.5	2,370.3
		13/32	44.5	15,081.1
		3/8	21.0	6,578.0
		11/32	19.5	5,605.1
		5/16	170.5	44,597.9
Sub-Total			262.0	74,232.4
Wisconsin:	30"	7/16	20.5	7,475.5
		13/32	10.6	3,592.3
		3/8	19.4	6,076.9
		11/32	37.7	10,836.5
		5/16	12.3	3,217.3
Sub-Total			100.5	31,199.5
Michigan:	30"	13/32	21.8	7,388.0
		3/8	32.5	10,180.3
		11/32	82.5	23,713.8
		5/16	161.0	42,269.7
	24"	1/2	3.5	1,166.8
Sub-Total			301.3	84,718.6
Ontario:	30"	13/32	60.8	20,605.1
		3/8	48.9	15,317.4
		11/32	99.0	28,456.6
		5/16	296.3	77,503.2
Sub-Total			505.0	141,887.3
Quebec:	24"	1/2	1.0	331.3
	30"	5/16	42.5	11,116.7
Sub-Total			43.5	11,448.0

SOUTHERN ROUTE--

Total Tons: 586,720.5

Total Delivered Cost: $146,800,000

3. ANALYSIS OF PIPE REQUIREMENTS, NORTHERN ROUTE

	OD	Wall	Miles	Tons
Alberta:	10 3/4"	1/4	73.5	5,441.2
	16"	1/4	71.5	7,937.2
	26"	13/32	6.65	1,949.6
		3/8	7.85	2,126.9
		11/32	9.5	2,362.3
		5/16	76.0	17,201.1
	30"	7/16	1.0	364.7
		13/32	7.5	2,542.4
		3/8	36.0	11,276.6
		11/32	13.5	3,880.4
		5/16	18.7	4,891.4
Sub-Total			321.70	59,973.8
Saskatchewan:	24"	1/2	1.52	503.6
	30"	7/16	8.0	2,917.3
		13/32	48.5	16,440.5
		3/8	62.5	19,577.5
		11/32	48.5	13,940.8
		5/16	234.3	61,285.8
Sub-Total			403.3	114,665.5
Manitoba:	30"	7/16	11.0	4,011.3
		13/32	44.5	15,084.6
		3/8	22.5	7,047.9
		11/32	82.0	23,570.1
		5/16	125.0	32,696.2
Sub-Total			285.0	82,410.1

	OD	Wall	Miles	Tons
Ontario:	30"	13/32	93.5	31,694.6
		3/8	117.0	36,649.1
		11/32	98.0	28,169.1
		5/16	426.5	111,559.6
Sub-Total			735.0	208,072.4
Quebec:	24"	1/2	1.0	331.3
	30"	7/16	6.0	2,188.0
		13/32	50.0	16,949.0
		3/8	39.0	12,216.4
		11/32	17.0	4,886.5
		5/16	293.5	76,770.8
Sub-Total			406.5	113,342.0
Grand Total			2,151.5	578,463.8

NORTHERN ROUTE--
Total Tons 578,463.8
Total Delivered Cost: $156,400,000

4. PIPELINE CONSTRUCTION COSTS, SOUTHERN ROUTE

a. Summary - Total Pipeline

(000 OMITTED)

Section	Province or State	FIRST YEAR PROGRAM (1958) Material Cost	Installation Cost	Total Cost	SECOND YEAR PROGRAM (1959) Material Cost	Installation Cost	Total Cost	Grand Totals
Western	Alberta	$ 8,873	$ 2,734	$11,607	$ 9,853	$ 2,961	$12,814	$24,421
	Saskatchewan	16,872	5,233	22,105	20,906	7,081	27,987	50,092
	Manitoba	-	-	-	10,025	3,155	13,180	13,180
	Direct Pipeline Cost	25,745	7,967	33,712	40,784	13,197	53,981	87,693
	Contingencies			1,686			2,699	4,385
	Engineering and Management			2,485			3,979	6,464
	Total Pipeline Cost - Western Section			37,883			60,659	98,542
Central	North Dakota	-	-	-	7,269	2,999	10,268	10,268
	Minnesota	11,070	5,290	16,360	6,749	3,232	9,981	26,341
	Wisconsin	-	-	-	7,299	3,563	10,862	10,862
	Michigan	7,912	6,053	13,965	13,024	7,879	20,903	34,868
	Direct Pipeline Cost	18,982	11,343	30,325	34,341	17,673	52,014	82,339
	Contingencies			1,517			2,601	4,118
	Engineering and Management			2,235			3,835	6,070
	Total Pipeline Cost - Central Section			34,077			58,450	92,527
Eastern	Ontario	15,204	14,311	29,515	25,409	21,982	47,391	76,906
	Quebec	3,756	2,344	6,100	316	1,575	1,891	7,991
	Direct Pipeline Cost	18,960	16,655	35,615	25,725	23,557	49,282	84,897
	Contingencies			1,781			2,464	4,245
	Engineering and Management			2,626			3,635	6,261
	Total Pipeline Cost - Eastern Section			40,022			55,381	95,403
	Total Pipeline Cost			111,982			174,490	286,472

b. Details - Western Section, Pipeline

A. Materials - Western Section	1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
1. Right of Way Easements and Damages			
(a) Alberta	$ 152,250	$ 187,050	$ 339,300
(b) Saskatchewan	204,750	248,400	453,150
(c) Manitoba	-	165,000	165,000
Total	357,000	600,450	957,450
2. Pipe			
(a) Alberta	5,933,520	7,072,595	13,006,115
(b) Saskatchewan	11,151,508	13,736,634	24,888,142
(c) Manitoba	-	6,882,511	6,882,511
Total	17,085,028	27,691,740	44,776,768
3. Pipe Freight			
(a) Alberta	1,275,451	1,161,301	2,436,752
(b) Saskatchewan	1,854,626	2,278,971	4,133,597
(c) Manitoba	-	968,992	968,992
Total	3,130,077	4,409,264	7,539,341
4. Highway and Railway Crossings			
(a) Alberta	14,372	29,060	43,432
(b) Saskatchewan	51,100	74,980	126,080
(c) Manitoba	-	41,495	41,495
Total	65,472	145,535	211,007
5. Coating Materials			
(a) Alberta	300,010	358,838	658,848
(b) Saskatchewan	555,274	669,444	1,224,718
(c) Manitoba	-	352,709	352,709
Total	855,284	1,380,991	2,236,275

SOUTHERN ROUTE

A. Materials (Continued)		1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
6. Concrete Weights				
(a) Alberta		$ 7,500	$ 17,000	$ 24,500
(b) Saskatchewan		37,500	90,000	127,500
(c) Manitoba		-	30,000	30,000
	Total	45,000	137,000	182,000
7. Mainline Valve Assemblies				
(a) Alberta		40,540	57,520	98,060
(b) Saskatchewan		111,510	127,440	238,950
(c) Manitoba		-	63,720	63,720
	Total	152,050	248,680	400,730
8. Scraper Traps				
(a) Alberta		51,720	85,280	137,000
(b) Saskatchewan		155,200	232,800	388,000
(c) Manitoba		-	116,400	116,400
	Total	206,920	434,480	641,400
9. River Crossing Manifolds				
(a) Alberta		-	-	-
(b) Saskatchewan		-	39,700	39,700
(c) Manitoba		-	-	-
	Total	-	39,700	39,700
10. Import Duties				
(a) Alberta		345,364	28,986	374,350
(b) Saskatchewan		826,751	1,025,574	1,852,325
(c) Manitoba		-	514,550	514,550
	Total	1,172,115	1,569,110	2,741,225

SOUTHERN ROUTE

A. Materials (Continued)	1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
11. Dominion Sales Tax			
(a) Alberta	$ 664,944	$ 758,239	$ 1,423,183
(b) Saskatchewan	1,276,028	1,579,425	2,855,453
(c) Manitoba	-	789,908	789,908
Total	1,940,972	3,127,572	5,068,544
12. Provincial Tax			
(a) Alberta	-	-	-
(b) Saskatchewan	480,585	595,649	1,076,234
(c) Manitoba	-	-	-
Total	480,585	595,649	1,076,234
13. Miscellaneous Materials			
(a) Alberta	87,329	97,131	184,460
(b) Saskatchewan	167,168	206,983	374,151
(c) Manitoba	-	99,715	99,715
Total	254,497	403,829	658,326
14. Total Material Cost - Western Section			
(a) Alberta	8,873,000	9,853,000	18,726,000
(b) Saskatchewan	16,872,000	20,906,000	37,778,000
(c) Manitoba	-	10,025,000	10,025,000
Total	25,745,000	40,784,000	66,529,000

SOUTHERN ROUTE

B. Installation - Western Section		1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
1. Pipeline				
(a) Alberta		$ 2,468,943	$ 2,733,595	$ 5,202,538
(b) Saskatchewan		4,829,092	5,772,411	10,601,503
(c) Manitoba		-	2,882,633	2,882,633
	Total	7,298,035	11,388,639	18,686,674
2. River and Stream Crossings				
(a) Alberta		85,000	-	85,000
(b) Saskatchewan		-	750,000	750,000
(c) Manitoba		-	-	-
	Total	85,000	750,000	835,000
3. Highway and Railway Crossings				
(a) Alberta		30,050	59,200	89,250
(b) Saskatchewan		100,000	148,750	248,750
(c) Manitoba		-	85,000	85,000
	Total	130,050	292,950	423,000
4. Valve Assemblies				
(a) Alberta		10,000	14,000	24,000
(b) Saskatchewan		24,500	28,000	52,500
(c) Manitoba		-	14,000	14,000
	Total	34,500	56,000	90,500
5. Scraper Traps				
(a) Alberta		10,500	14,000	24,500
(b) Saskatchewan		30,000	45,000	75,000
(c) Manitoba		-	22,500	22,500
	Total	40,500	81,500	122,000

SOUTHERN ROUTE

B. Installation (Continued)	1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
6. Testing and Miscellaneous Construction			
(a) Alberta	$ 129,507	$ 140,205	$ 269,712
(b) Saskatchewan	249,408	336,839	586,247
(c) Manitoba	-	150,867	150,867
Total	378,915	627,911	1,006,826
7. Total Installation Cost - Western Section			
(a) Alberta	2,734,000	2,961,000	5,695,000
(b) Saskatchewan	5,233,000	7,081,000	12,314,000
(c) Manitoba	-	3,155,000	3,155,000
Total	7,967,000	13,197,000	21,164,000
8. Total Direct Pipeline Cost - Western Section			
(a) Alberta	11,607,000	12,814,000	24,421,000
(b) Saskatchewan	22,105,000	27,987,000	50,092,000
(c) Manitoba	-	13,180,000	13,180,000
Total - Western Section	33,712,000	53,981,000	87,693,000

c. Details - Central Section, Pipeline

	1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
A. Materials - Central Section			
1. Right-of-Way Easements and Damages			
(a) North Dakota	$ -	$ 191,750	$ 191,750
(b) Minnesota	235,600	145,400	381,000
(c) Wisconsin	-	146,200	146,200
(d) Michigan	181,700	276,400	458,100
Total	417,300	759,750	1,177,050
2. Pipe			
(a) North Dakota	-	5,637,555	5,637,555
(b) Minnesota	8,825,102	5,408,884	14,233,986
(c) Wisconsin	-	5,889,936	5,889,936
(d) Michigan	5,965,149	10,236,642	16,201,791
Total	14,790,251	27,173,017	41,963,268
3. Pipe Freight			
(a) North Dakota	-	681,778	681,778
(b) Minnesota	920,480	564,160	1,484,640
(c) Wisconsin	-	624,000	624,000
(d) Michigan	497,520	851,280	1,348,800
Total	1,418,000	2,721,218	4,139,218
4. Highway and Railway Crossings			
(a) North Dakota	-	25,057	25,057
(b) Minnesota	45,469	22,125	67,594
(c) Wisconsin	-	39,281	39,281
(d) Michigan	27,960	67,066	95,026
Total	73,429	153,529	226,958

SOUTHERN ROUTE

A. Materials (Continued)		1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
5. Coating Materials				
(a) North Dakota		$ -	$ 329,308	$ 329,308
(b) Minnesota		502,653	310,083	812,736
(c) Wisconsin		-	311,801	311,801
(d) Michigan		340,597	590,021	930,618
	Total	843,250	1,541,213	2,384,463
6. Concrete Weights				
(a) North Dakota		-	30,000	30,000
(b) Minnesota		180,000	90,000	270,000
(c) Wisconsin		-	90,000	90,000
(d) Michigan		315,000	240,000	555,000
	Total	495,000	450,000	945,000
7. Main Line Valve Assemblies				
(a) North Dakota		-	47,790	47,790
(b) Minnesota		95,580	63,720	159,300
(c) Wisconsin		-	47,790	47,790
(d) Michigan		47,790	111,510	159,300
	Total	143,370	270,810	414,180
8. Scraper Traps				
(a) North Dakota		-	116,400	116,400
(b) Minnesota		155,200	77,600	232,800
(c) Wisconsin		-	77,600	77,600
(d) Michigan		155,200	155,200	310,400
	Total	310,400	426,800	737,200
9. Lake Crossing Manifolds				
(a) Michigan		79,400	-	79,400
	Total	79,400	-	79,400

SOUTHERN ROUTE

A. Materials (Continued)	1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
10. State Taxes			
(a) North Dakota	$ -	$ 137,358	$ 137,358
(b) Minnesota	-	-	-
(c) Wisconsin	-	-	-
(d) Michigan	222,858	367,552	590,410
Total	222,858	504,910	727,768
11. Miscellaneous Material			
(a) North Dakota	-	72,004	72,004
(b) Minnesota	109,916	67,028	176,944
(c) Wisconsin	-	72,392	72,392
(d) Michigan	78,826	128,329	207,155
Total	188,742	339,753	528,495
12. Total Material Cost - Central Section			
(a) North Dakota	-	7,269,000	7,269,000
(b) Minnesota	11,070,000	6,749,000	17,819,000
(c) Wisconsin	-	7,299,000	7,299,000
(d) Michigan	7,912,000	13,024,000	20,936,000
Total	18,982,000	34,341,000	53,323,000

B. Installation - Central Section		1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
1. Pipeline				
(a) North Dakota		$ -	$ 2,768,290	$ 2,768,290
(b) Minnesota		4,884,334	2,999,040	7,883,374
(c) Wisconsin		-	3,279,108	3,279,108
(d) Michigan		3,910,599	7,293,264	11,203,863
	Total	8,794,933	16,339,702	25,134,635
2. River and Stream Crossings				
(a) Michigan		1,750,000	-	1,750,000
	Total	1,750,000	-	1,750,000
3. Highway and Railway Crossings				
(a) North Dakota		-	55,000	55,000
(b) Minnesota		103,250	50,000	153,250
(c) Wisconsin		-	88,750	88,750
(d) Michigan		63,750	155,750	219,500
	Total	167,000	349,500	516,500
4. Valve Assemblies				
(a) North Dakota		-	10,500	10,500
(b) Minnesota		21,000	14,000	35,000
(c) Wisconsin		-	10,500	10,500
(d) Michigan		10,500	24,500	35,000
	Total	31,500	59,500	91,000
5. Scraper Traps				
(a) North Dakota		-	22,500	22,500
(b) Minnesota		30,000	15,000	45,000
(c) Wisconsin		-	15,000	15,000
(d) Michigan		30,000	30,000	60,000
	Total	60,000	82,500	142,500

SOUTHERN ROUTE

B. Installation (Continued)

	1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
6. Testing and Miscellaneous Construction			
(a) North Dakota	$ -	$ 142,710	$ 142,710
(b) Minnesota	251,416	153,960	405,376
(c) Wisconsin	-	169,642	169,642
(d) Michigan	288,151	375,486	663,637
Total	539,567	841,798	1,381,365
7. Total Installation Cost - Central Section			
(a) North Dakota	-	2,999,000	2,999,000
(b) Minnesota	5,290,000	3,232,000	8,522,000
(c) Wisconsin	-	3,563,000	3,563,000
(d) Michigan	6,053,000	7,879,000	13,932,000
Total	11,343,000	17,673,000	29,016,000
8. Total Direct Pipeline Cost - Central Section			
(a) North Dakota	-	10,268,000	10,268,000
(b) Minnesota	16,360,000	9,981,000	26,341,000
(c) Wisconsin	-	10,862,000	10,862,000
(d) Michigan	13,965,000	20,903,000	34,868,000
Total - Central Section	30,325,000	52,014,000	82,339,000

d. Details - Eastern Section, Pipeline

A. Materials - Eastern Section	1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
1. Right-of-Way Easements and Damages			
(a) Ontario	$ 207,000	$ 345,600	$ 552,600
(b) Quebec	309,000	100,000	409,000
Total	516,000	445,600	961,600
2. Pipe			
(a) Ontario	10,989,927	18,316,682	29,306,609
(b) Quebec	2,323,244	68,931	2,392,175
Total	13,313,171	18,385,613	31,698,784
3. Pipe Freight			
(a) Ontario	813,832	1,356,396	2,170,228
(b) Quebec	183,414	2,979	186,393
Total	997,246	1,359,375	2,356,621
4. Highway and Railway Crossings			
(a) Ontario	89,675	171,680	261,355
(b) Quebec	67,950	-	67,950
Total	157,625	171,680	329,305
5. Coating Materials			
(a) Ontario	564,256	940,776	1,505,032
(b) Quebec	127,620	2,975	130,595
Total	691,876	943,751	1,635,627
6. Concrete Weights			
(a) Ontario	67,500	127,500	195,000
(b) Quebec	30,000	75,000	105,000
Total	97,500	202,500	300,000

SOUTHERN ROUTE

		1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
A. Materials (Continued)				
7. MainLine Valve Assemblies				
(a) Ontario		$ 95,580	$ 175,230	$ 270,810
(b) Quebec		15,930	-	15,930
	Total	111,510	175,230	286,740
8. Scraper Traps				
(a) Ontario		155,200	232,800	388,000
(b) Quebec		116,400	-	116,400
	Total	271,600	232,800	504,400
9. River Crossing Manifolds				
(b) Quebec		-	39,700	39,700
	Total	-	39,700	39,700
10. Import Duties				
(a) Ontario		829,325	1,384,082	2,213,407
(b) Quebec		196,309	7,000	203,309
	Total	1,025,634	1,391,082	2,416,716
11. Dominion Sales Tax				
(a) Ontario		1,241,307	2,106,643	3,347,950
(b) Quebec		281,839	11,865	293,704
	Total	1,523,146	2,118,508	3,641,654
12. Provincial Tax				
(a) Ontario		-	-	-
(b) Quebec		66,854	4,169	71,023
	Total	66,854	4,169	71,023

	1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
A. Materials (Continued)			
13. Miscellaneous Materials			
(a) Ontario	$ 150,398	$ 251,611	$ 402,009
(b) Quebec	37,440	3,381	40,821
Total	187,838	254,992	442,830
14. Total Material Costs - Eastern Section			
(a) Ontario	15,204,000	25,409,000	40,613,000
(b) Quebec	3,756,000	316,000	4,072,000
Total - Eastern Section	18,960,000	25,725,000	44,685,000

		1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
B. Installation - Eastern Section				
1. Pipelines				
(a) Ontario		$13,181,056	$20,072,400	$33,253,456
(b) Quebec		2,006,136	-	2,006,136
	Total	15,187,192	20,072,400	35,259,592
2. River and Stream Crossings				
(a) Ontario		200,000	400,000	600,000
(b) Quebec		50,000	1,500,000	1,550,000
	Total	250,000	1,900,000	2,150,000
3. Highway and Railway Crossings				
(a) Ontario		197,500	379,750	577,250
(b) Quebec		150,000	-	150,000
	Total	347,500	379,750	727,250
4. Valve Assemblies				
(a) Ontario		21,000	38,500	59,500
(b) Quebec		3,500	-	3,500
	Total	24,500	38,500	63,000
5. Scraper Traps				
(a) Ontario		30,000	45,000	75,000
(b) Quebec		22,500	-	22,500
	Total	52,500	45,000	97,500
6. Testing and Miscellaneous Construction				
(a) Ontario		681,444	1,107,006	1,788,450
(b) Quebec		111,864	75,000	186,864
	Total	793,308	1,182,006	1,975,314

	1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
B. Installation (Continued)			
7. Total Installation Cost			
(a) Ontario	$14,311,000	$21,982,000	$36,293,000
(b) Quebec	2,344,000	1,575,000	3,919,000
Total	16,655,000	23,557,000	40,212,000
8. Total Direct Pipeline Cost - Eastern Section			
(a) Ontario	29,515,000	47,391,000	76,906,000
(b) Quebec	6,100,000	1,891,000	7,991,000
Total - Eastern Section	35,615,000	49,282,000	84,897,000

SOUTHERN ROUTE

4. PIPELINE CONSTRUCTION COSTS, NORTHERN ROUTE

a. Summary - Total Pipeline

(000 OMITTED)

		FIRST YEAR PROGRAM (1958)			SECOND YEAR PROGRAM (1959)			
Section	Province	Material Cost	Installation Cost	Total Cost	Material Cost	Installation Cost	Total Cost	Grand Totals
Western	Alberta	$ 8,873	$ 2,734	$11,607	$ 9,853	$ 2,961	$ 12,814	$ 24,421
	Saskatchewan	15,353	4,765	20,118	20,612	7,265	27,877	47,995
	Manitoba	4,357	2,455	6,812	19,986	7,323	27,309	34,121
	Direct Pipeline Cost	28,583	9,954	38,537	50,451	17,549	68,000	106,537
	Contingencies			1,927			3,400	5,327
	Engineering and Management			2,832			4,998	7,830
	Total Pipeline Cost - Western Section			43,296			76,398	119,694
Eastern	Ontario	23,675	20,150	43,825	36,449	33,837	70,286	114,111
	Quebec	15,268	12,900	28,168	19,626	16,787	36,413	64,581
	Direct Pipeline Cost	38,943	33,050	71,993	56,075	50,624	106,699	178,692
	Contingencies			3,600			5,334	8,934
	Engineering and Management			5,292			7,842	13,134
	Total Pipeline Cost - Eastern Section			80,885			119,875	200,760
	Total Pipeline Cost							320,454

b. Details - Western Section, Pipeline

	1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
A. Materials - Western Section			
1. Right of Way Easements and Damages			
(a) Alberta	$ 152,250	$ 187,050	$ 339,300
(b) Saskatchewan	189,000	251,400	440,400
(c) Manitoba	73,000	342,000	415,000
Total	414,250	780,450	1,194,700
2. Pipe			
(a) Alberta	5,933,520	7,072,595	13,006,115
(b) Saskatchewan	10,420,995	13,831,647	24,252,642
(c) Manitoba	3,005,997	14,126,201	17,132,198
Total	19,360,512	35,030,443	54,390,955
3. Pipe Freight			
(a) Alberta	1,275,451	1,161,301	2,436,752
(b) Saskatchewan	1,573,802	2,084,188	3,657,990
(c) Manitoba	379,285	1,783,875	2,163,160
Total	3,228,538	5,029,364	8,257,902
4. Highway and Railway Crossings			
(a) Alberta	14,372	29,060	43,432
(b) Saskatchewan	50,895	82,475	133,370
(c) Manitoba	12,425	74,633	87,058
Total	77,692	186,168	263,860
5. Coating Materials			
(a) Alberta	300,010	358,838	658,848
(b) Saskatchewan	514,010	681,921	1,195,931
(c) Manitoba	156,163	731,828	887,991
Total	970,183	1,772,587	2,742,770

A. Materials (Continued)		1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
6. Concrete Weights				
(a) Alberta		$ 7,500	$ 17,000	$ 24,500
(b) Saskatchewan		37,500	90,000	127,500
(c) Manitoba		60,000	82,500	142,500
	Total	105,000	189,500	294,500
7. Mainline Valve Assemblies				
(a) Alberta		40,540	57,520	98,060
(b) Saskatchewan		111,510	127,440	238,950
(c) Manitoba		31,860	127,440	159,300
	Total	183,910	312,400	496,310
8. Scraper Traps				
(a) Alberta		51,720	85,280	137,000
(b) Saskatchewan		116,400	271,600	388,000
(c) Manitoba		77,600	155,200	232,800
	Total	245,720	512,080	757,800
9. River Crossing Manifolds				
(a) Alberta		-	-	-
(b) Saskatchewan		-	39,700	39,700
(c) Manitoba		-	-	-
	Total	-	39,700	39,700
10. Import Duties				
(a) Alberta		345,364	28,986	374,350
(b) Saskatchewan		578,678	789,081	1,367,759
(c) Manitoba		174,380	779,870	954,250
	Total	1,098,422	1,597,937	2,696,359

NORTHERN ROUTE

A. Materials (Continued)

	1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
11. Dominion Sales Tax			
(a) Alberta	$ 664,944	$ 758,239	$ 1,423,183
(b) Saskatchewan	1,170,671	1,570,784	2,741,455
(c) Manitoba	342,733	1,585,062	1,927,795
Total	2,178,348	3,914,085	6,092,433
12. Provincial Tax			
(a) Alberta	-	-	-
(b) Saskatchewan	437,234	587,065	1,024,299
(c) Manitoba	-	-	-
Total	437,234	587,065	1,024,299
13. Miscellaneous Materials			
(a) Alberta	87,329	97,131	184,460
(b) Saskatchewan	152,305	204,699	357,004
(c) Manitoba	43,557	197,391	240,948
Total	283,191	499,221	782,412
14. Total Material Cost - Western Section			
(a) Alberta	8,873,000	9,853,000	18,726,000
(b) Saskatchewan	15,353,000	20,612,000	35,965,000
(c) Manitoba	4,357,000	19,986,000	24,343,000
Total	28,583,000	50,451,000	79,034,000

B. Installation - Western Section	1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
1. Pipeline			
(a) Alberta	$ 2,468,943	$ 2,733,595	$ 5,202,538
(b) Saskatchewan	4,389,600	5,925,648	10,315,248
(c) Manitoba	2,291,520	6,762,360	9,053,880
Total	9,150,063	15,421,603	24,571,666
2. River and Stream Crossings			
(a) Alberta	85,000	-	85,000
(b) Saskatchewan	-	750,000	750,000
(c) Manitoba	-	-	-
Total	85,000	750,000	835,000
3. Highway and Railway Crossings			
(a) Alberta	30,050	59,200	89,250
(b) Saskatchewan	101,250	162,500	263,750
(c) Manitoba	25,000	153,750	178,750
Total	156,300	375,450	531,750
4. Valve Assemblies			
(a) Alberta	10,000	14,000	24,000
(b) Saskatchewan	24,500	28,000	52,500
(c) Manitoba	7,000	28,000	35,000
Total	41,500	70,000	111,500
5. Scraper Traps			
(a) Alberta	10,500	14,000	24,500
(b) Saskatchewan	22,500	52,500	75,000
(c) Manitoba	15,000	30,000	45,000
Total	48,000	96,500	144,500

B. Installation (Continued)	1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
6. Testing and Miscellaneous Construction			
(a) Alberta	$ 129,507	$ 140,205	$ 269,712
(b) Saskatchewan	227,150	346,352	573,502
(c) Manitoba	116,480	348,890	465,370
Total	473,137	835,447	1,308,584
7. Total Installation Cost - Western Section			
(a) Alberta	2,734,000	2,961,000	5,695,000
(b) Saskatchewan	4,765,000	7,265,000	12,030,000
(c) Manitoba	2,455,000	7,323,000	9,778,000
Total	9,954,000	17,549,000	27,503,000
8. Total Direct Pipeline Cost - Western Section			
(a) Alberta	11,607,000	12,814,000	24,421,000
(b) Saskatchewan	20,118,000	27,877,000	47,995,000
(c) Manitoba	6,812,000	27,309,000	34,121,000
Total - Western Section	38,537,000	68,000,000	106,537,000

c. Details - Eastern Section, Pipeline

A. Materials - Eastern Section		1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
1. Right of way Easements and Damages				
(a) Ontario		$ 210,000	$ 325,000	$ 535,000
(b) Quebec		256,000	334,600	590,600
	Total	466,000	659,600	1,125,600
2. Pipe				
(a) Ontario		17,087,163	26,502,621	43,589,784
(b) Quebec		10,448,343	13,639,666	24,088,009
	Total	27,535,506	40,142,287	67,677,793
3. Pipe Freight				
(a) Ontario		1,463,047	2,269,245	3,732,292
(b) Quebec		1,087,666	1,415,681	2,503,347
	Total	2,550,713	3,684,926	6,235,639
4. Highway and Railway Crossings				
(a) Ontario		61,150	36,025	97,175
(b) Quebec		41,325	100,840	142,165
	Total	102,475	136,865	239,340
5. Coating Materials				
(a) Ontario		924,730	1,433,240	2,357,970
(b) Quebec		550,480	749,590	1,300,070
	Total	1,475,210	2,182,830	3,658,040
6. Concrete Weights				
(a) Ontario		337,500	572,500	910,000
(b) Quebec		285,000	270,000	555,000
	Total	622,500	742,500	1,465,000

NORTHERN ROUTE

		1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
A. Materials (Continued)				
7. Mainline Valve Assemblies				
(a) Ontario		$ 143,370	$ 286,740	$ 430,110
(b) Quebec		47,800	175,200	223,000
	Total	191,170	461,940	653,110
8. Scraper Traps				
(a) Ontario		310,400	232,800	543,200
(b) Quebec		310,400	77,600	388,000
	Total	620,800	310,400	931,200
9. River Crossing Manifolds				
(a) Ontario		-	-	-
(b) Quebec		-	-	-
	Total	-	-	-
10. Import Duties				
(a) Ontario		971,577	1,463,356	2,434,933
(b) Quebec		611,273	765,618	1,376,891
	Total	1,582,850	2,228,974	3,811,824
11. Dominion Sales Tax				
(a) Ontario		1,931,134	2,966,776	4,897,910
(b) Quebec		1,186,969	1,528,304	2,715,273
	Total	3,118,103	4,495,080	7,613,183
12. Provincial Tax				
(a) Ontario		-	-	-
(b) Quebec		291,385	374,450	665,835
	Total	291,385	374,450	665,835

NORTHERN ROUTE

	1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
A. Materials (Continued)			
13. Miscellaneous Materials			
(a) Ontario	$ 234,929	$ 360,697	$ 595,626
(b) Quebec	151,359	194,451	345,810
Total	386,288	555,148	941,436
14. Total Material Costs - Eastern Section			
(a) Ontario	23,675,000	36,449,000	60,124,000
(b) Quebec	15,268,000	19,626,000	34,894,000
Total - Eastern Section	38,943,000	56,075,000	95,018,000

B. Installation - Eastern Section		1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
1. Pipelines				
(a) Ontario		$18,963,000	$32,038,000	$51,001,000
(b) Quebec		12,122,500	15,704,000	27,826,500
	Total	31,085,500	47,742,000	78,827,500
2. Highway and Railway Crossings				
(a) Ontario		136,250	80,000	216,250
(b) Quebec		92,500	230,000	322,500
	Total	228,750	310,000	538,750
3. Valve Assemblies				
(a) Ontario		31,500	63,000	94,500
(b) Quebec		10,500	38,500	49,000
	Total	42,000	101,500	143,500
4. Scraper Traps				
(a) Ontario		60,000	45,000	105,000
(b) Quebec		60,000	15,000	75,000
	Total	120,000	60,000	180,000
5. Testing and Miscellaneous Construction				
(a) Ontario		959,250	1,611,000	2,570,250
(b) Quebec		614,500	799,500	1,414,000
	Total	1,573,750	2,410,500	3,984,250

B. Installation (Continued)	1958 PROGRAM Total Cost	1959 PROGRAM Total Cost	Grand Totals
6. Total Installation Cost			
(a) Ontario	$20,150,000	$33,837,000	$53,987,000
(b) Quebec	12,900,000	16,787,000	29,687,000
Total	33,050,000	50,624,000	83,674,000
7. Total Direct Pipeline Cost - Eastern Section			
(a) Ontario	43,825,000	70,286,000	114,111,000
(b) Quebec	28,168,000	36,413,000	64,581,000
Total - Eastern Section	71,993,000	106,699,000	178,692,000

5. PUMP STATION AND TANKAGE COSTS

Description of Items Listed In Investment Cost for Stations

LAND IN FEE

STORAGE TANKS -- Standard A. P. I. welded steel tanks, erected complete with standard fittings. Includes foundations, grading, firewalls and firewall drains.

MAIN LINE & BOOSTER PUMPING UNITS -- Includes complete units installed, foundations and cooling water systems.

MAIN STATION PIPING & EQUIPMENT -- Includes pipe, valves, fittings, control valves, strainers, foundations and catwalks.

AUXILIARY STATION PIPING & EQUIPMENT -- For fuel systems, air systems, oil drain systems, fire fighting equipment, and miscellaneous. Includes pipe, valves, fittings, pumps, compressors, air dryers, centrifuges, foundations, fuel tanks with firewalls, portable boiler and heating coils, sump tank, fire fighting equipment and miscellaneous equipment.

METERING FACILITIES -- Includes meters, pipe, valves, fittings, strainers, provers, pumps, foundations, shelters and catwalks.

ELECTRICAL SYSTEM, INSTRUMENTS AND CONTROLS -- (Source of power indicated on summaries) Includes generators (if required), switchgear, circuit panels, yard lighting, grounding, distribution, control console, recording and indicating instruments and alarms.

BUILDINGS -- Pumps and office buildings, includes foundations, superstructure, lighting, plumbing and fixtures, heating system, boiler and miscellaneous furniture.

STATION SITE DEVELOPMENT -- Includes station roads, access roads (where required), sidewalks, station grading, perimeter fence, water supply system (well, if required) and sewage disposal system.

STAFF HOUSING

SUMMARY OF INVESTMENT COSTS - STATIONS
(In Thousands of Dollars)

30" LINE - SOUTH ROUTE

Stations	1960	1962	1963	1964	1965	1967	1968	Total	Material	Construc- tion	Omission & Contingencies	Engineering & Management
Edmonton	4203	389			1322	330		6244	3417	1889	530	408
Calgary	415		86		70			571	279	207	48	37
Britamoil	1222		16	191	9			1438	789	433	122	94
Bellshill Lake	5775		66	10	1787		337	7975	4147	2627	679	522
9 Intermediate	5278*		6598*		3156		3019	18051	11142	4194	1533	1182
Montreal	569		33		33			635	336	204	54	41
TOTAL INVESTMENT (CANADA)	17462	389	6799	201	6377	330	3356	34914	20110	9554	2966	2284
6 Intermediate	3528**		3528**		1879		1779	10714	6564	2538	911	701
TOTAL INVESTMENT (U.S.)	3528		3528		1879		1779	10714	6564	2538	911	701
TOTAL INVESTMENT	20990	389	10327	201	8256	330	5135	45628	26674	12092	3877	2985

* Canada 1960 - 4 Stations
1963 - 5 Stations

** U.S. 1960 - 3 Stations
1963 - 3 Stations

SUMMARY 30" SOUTH

SUMMARY OF INVESTMENT COSTS - STATIONS
(In Thousands of Dollars)

30" LINE - NORTH ROUTE

Stations	1960	1962	1963	1964	1965	1967	1968	Total	Material	Construc-tion	Omission & Contingencies	Engineering & Management
Edmonton	4203	389			1322	330		6244	3417	1889	530	408
Calgary	415		86		70			571	279	207	48	37
Britamoil Jct.	1222		16	191	9			1438	789	433	122	94
Bellshill Lake	5775		66	10	1787		337	7975	4147	2627	679	522
15 Intermediate	9233*		10552*		5261		5031	30077	18567	6987	2556	1967
Booster	385							385	238	89	33	25
Montreal	569		33		33			635	336	204	54	41
TOTAL INVESTMENT (CANADA)	21802	389	10753	201	8482	330	5368	47325	27773	12436	4022	3094

* 1960 - 7 Stations
1963 - 8 Stations

APPLIES TO:
30" Line - South Route
30" Line - North Route

EDMONTON STATION
INVESTMENT COSTS (CANADA)
(Thousands of Dollars)

ITEM	1960 Matl	1960 Const	1962 Matl	1962 Const	1965 Matl	1965 Const	1967 Matl	1967 Const	Total Matl	Total Const
Land in Fee	50								50	
Storage Tanks										
100,000 Bbl.	915	551							915	551
100,000 Bbl.					343	268			343	268
Main Line & Booster Pumping Units	346	40	194	29	183	27	183	27	906	123
Main Station Piping & Equipment	629	415	52	32	149	95	37	20	867	562
Auxiliary Station Piping & Equipment	42	25	1	2	2	4	2	4	47	35
Electrical System, Instruments & Controls (Public Power)	153	217	6	9	10	12	3	4	172	242
Station Buildings	78	63	1	5	14	17			93	85
Station Site Development	24	23							24	23
Sub Totals	2237	1334	254	77	701	423	225	55	3417	1889
Total Material & Construction	3571		331		1124		280		5306	
Omissions & Contingencies	357		33		112		28		530	
Engineering & Management	275		25		86		22		408	
TOTAL INVESTMENT (CANADA)	4203		389		1322		330		6244	

EDMONTON

APPLIES TO:
30" Line - South Route
30" Line - North Route

CALGARY STATION
INVESTMENT COSTS (CANADA)
(Thousands of Dollars)

ITEM	1960 Matl	1960 Const	1963 Matl	1963 Const	1965 Matl	1965 Const	Total Matl	Total Const
Land in Fee	20						20	
Storage Tanks 50,000 Bbl.	60	63					60	63
Main Line & Booster Pumping Units	2	1	15	3	17	4	34	8
Main Station Piping & Equipment	18	12	13	7	13	7	44	26
Auxiliary Station Piping & Equipment	3	5					3	5
Metering Facilities	19	13			2	1	21	14
Electrical System, Instruments & Controls (Public Power)	42	34	4	5	5	7	51	46
Station Buildings	23	24	15	12	1	2	39	38
Station Site Development	7	7					7	7
Sub Totals	194	159	47	27	38	21	279	207
Total Material & Construction	353		74		59		486	
Omissions & Contingencies	35		7		6		48	
Engineering & Management	27		5		5		37	
TOTAL INVESTMENT (CANADA)	415		86		70		571	

CALGARY

APPLIES TO:
30" Line - South Route
30" Line - North Route

BRITAMOIL STATION
INVESTMENT COSTS (CANADA)
(Thousands of Dollars)

ITEM	1960 Matl	1960 Const	1963 Matl	1963 Const	1964 Matl	1964 Const	1965 Matl	1965 Const	Total Matl	Total Const
Land in Fee	20								20	
Storage Tanks: 30,000 Bbl.	41	45							41	45
Main Line & Booster Pumping Units	213	40	2	1	101	19			316	60
Main Station Piping & Equipment	90	54	2	2	19	10			111	66
Auxiliary Station Piping & Equipment	41	25			1	2			42	27
Metering Facilities	58	35					3	2	61	37
Electrical System, Instruments & Controls (Station Generators)	37	35	4	3	3	2	1	1	45	41
Station Buildings	78	62			1	5			79	67
Station Site Development	24	40							24	40
Staff Housing	50	50							50	50
Sub Totals	652	386	8	6	125	38	4	3	789	433
Total Material & Construction	1038		14		163		7		1222	
Omissions & Contingencies	104		1		16		1		122	
Engineering & Management	80		1		12		1		94	
TOTAL INVESTMENT (CANADA)	1222		16		191		9		1438	

BRITAMOIL

BELLSHILL STATION
INVESTMENT COSTS (CANADA)
(Thousands of Dollars)

APPLIES TO:
30" Line - South Route
30" Line - North Route

ITEM	1960 Matl	1960 Const	1963 Matl	1963 Const	1964 Matl	1964 Const	1965 Matl	1965 Const	1968 Matl	1968 Const	Total Matl	Total Const
Land in Fee	50										50	
Storage Tanks:												
150,000 Bbl.	685	458					343	229			1028	687
96,000 Bbl.	219	169					146	84			365	253
42,500 Bbl.	106	105					53	53			159	158
Main Line & Booster Pumping Units	426	59	12	2			183	27	183	27	804	115
Main Station Piping & Equipment	926	712	10	8			212	130	39	22	1187	872
Auxiliary Station Piping & Equipment	43	30					1	2	1	2	45	34
Metering Facilities	149	88	11	7	5	3	12	7			177	105
Electrical System, Instrument & Controls (Public Power)	153	217	3	3			9	12	3	3	168	235
Station Buildings	77	61					7	8	1	5	85	74
Station Site Development	29	44									29	44
Staff Housing	50	50									50	50
Sub Totals	2913	1993	36	20	5	3	966	552	227	59	4147	2627
Total Material & Construction	4906		56		8		1518		286		6774	
Omissions & Contingencies	491		6		1		152		29		679	
Engineering & Management	378		4		1		117		22		522	
TOTAL INVESTMENT (CANADA)	5775		66		10		1787		337		7975	

BELLSHILL

TYPICAL INTERMEDIATE STATION INVESTMENT COSTS (UNITED STATES)

(Thousands of Dollars)

APPLIES TO:
30" Line - South Route

ITEM	1960 or 1963 Matl	1960 or 1963 Const	1965 Matl	1965 Const	1968 Matl	1968 Const	Total Matl	Total Const
Land in Fee	10						10	
Main Line & Booster Pumping Units	332	44	167	25	167	25	666	94
Main Station Piping & Equipment	152	89	33	19	33	19	218	127
Auxiliary Station Piping & Equipment	4	7	1	2	1	2	6	11
Electrical System, Instruments & Controls (Station Generators)	33	27	2	2	2	3	37	32
Station Buildings	77	62	7	8			84	70
Station Site Development	23	39					23	39
Staff Housing	50	50					50	50
Sub Totals	681	318	210	56	203	49	1094	423
Total Material & Construction	999		266		252		1517	
Omissions & Contingencies	100		27		25		152	
Engineering & Management	77		20		19		116	
TOTAL INVESTMENT (UNITED STATES)	1176		313		296		1785	

TYPICAL INTERMEDIATE

TYPICAL INTERMEDIATE STATION INVESTMENT COSTS (CANADA)
(Thousands of Dollars)

APPLIES TO:
30" Line - South Route
30" Line - North Route

ITEM	1960 or 1963 Matl	1960 or 1963 Const	1965 Matl	1965 Const	1968 Matl	1968 Const	Total Matl	Total Const
Land in Fee	10						10	
Main Line & Booster Pumping Units	362	48	183	27	183	27	728	102
Main Station Piping & Equipment	203	117	44	22	44	23	291	162
Auxiliary Station Piping & Equipment	4	7	1	2	1	2	6	11
Electrical System, Instruments & Controls (Station Generators)	42	27	2	2	2	3	46	32
Station Buildings	77	62	7	8			84	70
Station Site Development	23	39					23	39
Staff Housing	50	50					50	50
Sub Totals	771	350	237	61	230	55	1238	466
Total Material & Construction	1121		298		285		1704	
Omissions & Contingencies	112		30		29		171	
Engineering & Management	86		23		22		131	
TOTAL INVESTMENT (CANADA)	1319		351		336		2006	

TYPICAL INTERMEDIATE

APPLIES TO:
30" Line - South Route
30" Line - North Route

MONTREAL TERMINAL
INVESTMENT COSTS (CANADA)
(Thousands of Dollars)

ITEM	1960		1963		1965		Total	
	Matl	Const	Matl	Const	Matl	Const	Matl	Const
Land in Fee	10						10	
Main Station Piping & Equipment	51	28					51	28
Auxiliary Station Piping & Equipment	3	3					3	3
Metering Facilities	175	99	17	11	17	11	209	121
Electrical System, Instruments & Controls (Public Power)	31	19					31	19
Station Buildings	22	23					22	23
Station Site Development	10	10					10	10
Sub Totals	302	182	17	11	17	11	336	204
Total Material & Construction	484		28		28		540	
Omissions & Contingencies	48		3		3		54	
Engineering & Management	37		2		2		41	
TOTAL INVESTMENT (CANADA)	569		33		33		635	

B. ESTIMATED ANNUAL OPERATING COSTS

1. SUMMARY OF ANNUAL OPERATING COSTS

SOUTHERN ROUTE
(000 Omitted)

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
(1) Stations, excluding labor and tankage	$1,135	$1,578	$2,174	$2,819	$3,636	$4,487	$5,216	$6,003	$6,898	$7,707
(2) Station and Terminal Labor	792	792	792	1,293	1,293	1,293	1,293	1,293	1,293	1,293
(3) Tank Maintenance	70	70	70	70	70	100	100	100	100	100
(4) Pipeline Maintenance	989	989	989	989	989	989	989	989	989	989
(5) Communications	433	433	433	433	433	433	433	433	433	433
Subtotal	3,419	3,862	4,458	5,604	6,421	7,302	8,031	8,818	9,713	10,522
*(6) Administration	914	914	914	1,114	1,114	1,126	1,126	1,126	1,126	1,126
Total	$4,333	$4,776	$5,372	$6,718	$7,535	$8,428	$9,157	$9,944	$10,839	$11,648

2. SUMMARY OF ANNUAL OPERATING COSTS

NORTHERN ROUTE
(000 Omitted)

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
(1) Stations, excluding labor and tankage	$1,187	$1,626	$2,217	$2,855	$3,636	$4,496	$5,203	$5,978	$6,856	$7,653
(2) Station and Terminal Labor	792	792	792	1,293	1,293	1,293	1,293	1,293	1,293	1,293
(3) Tank Maintenance	70	70	70	70	70	100	100	100	100	100
(4) Pipeline Maintenance	1,122	1,122	1,122	1,122	1,122	1,122	1,122	1,122	1,122	1,122
(5) Communications	430	430	430	430	430	430	430	430	430	430
Subtotal	3,601	4,040	4,631	5,770	6,551	7,441	8,148	8,923	9,801	10,598
*(6) Administration	966	966	966	1,166	1,166	1,178	1,178	1,178	1,178	1,178
Total	4,567	5,006	5,597	6,936	7,717	8,619	9,326	10,101	10,979	11,776

* Administration is computed as 40% of items (2), (3), (4) and (5).

Small tools, supplies, and automotive and maintenance equipment are included in station and pipeline maintenance and administration costs.

3. STATION OPERATING COST EXCLUDING LABOR AND TANKAGE

Southern Route	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Operating Horsepower per Hour										
Calgary-Britamoil Jct.	5	6	7	12	45	132	268	272	284	296
Booster Pumps					19	23	27	28	28	28
Britamoil Jct. -Bellshill Lake	229	345	487	659	856	1,086	1,355	1,392	1,448	1,488
Booster Pumps	49	55	61	66	72	78	83	84	85	86
Edmonton-Bellshill Lake	1,113	1,520	1,990	2,560	3,200	3,960	4,470	5,240	6,110	7,040
Booster Pumps	150	169	187	206	225	243	255	271	287	303
Bellshill Lake Boosters	204	228	253	277	302	326	343	360	377	393
Total Without Main Line	1,750	2,323	2,985	3,780	4,719	5,848	6,801	7,647	8,619	9,634
Main Line, Southern Route	17,480	24,420	33,850	44,000	56,900	70,200	81,600	94,100	108,300	121,000
Total, Southern Route	19,230	26,740	36,840	47,780	61,620	76,050	88,400	101,750	116,920	130,630
Main Line, Northern Route	18,370	25,240	34,580	44,610	56,910	70,350	81,380	93,670	107,580	120,080
Total, Northern Route	20,120	27,560	37,570	48,390	61,630	76,200	88,180	101,320	116,200	129,710
Operating Cost @ $59.00 per Operating BHP: (000 Omitted)										
Southern Route	$1,135	$1,578	$2,174	$2,819	$3,636	$4,487	$5,216	$6,003	$6,898	$7,707
Northern Route	1,187	1,626	2,217	2,855	3,636	4,496	5,203	5,978	6,856	7,653

STATION OPERATING COST DETAILS

Fuel (crude oil) consumption per BHP Hour	= 0.35 lb.	
Fuel oil cost per barrel, including average transportation cost	= $3.00	
Fuel oil cost per pound	= $0.01	
Fuel oil cost per BHP Hour	= $0.0035	
Fuel oil cost per BHP Year @ 98% Load Factor = 8585 hrs. x $0.0035	=	$30.05
Lube oil consumption = 1 gallon/3000 BHP Hours		
Lube oil cost per gallon, including average transportation cost	= $0.90	
Lube oil cost per BHP Hour	= $0.003	
Lube oil cost per BHP Year (8585 hrs.)	=	$ 2.60
Repairs and renewals, excluding labor per operating BHP Year (Operating HP is approximately 75% of installed HP for ten-year period)		$26.00
Total annual operating cost per operating BHP, excluding labor		$58.65
		($59.00)

4. ESTIMATED ANNUAL STATION PERSONNEL EXPENSE

1) Edmonton

1 Station superintendent	$ 9,600
4 Shift operators	26,400
1 Electrical technician	7,200
1 Electrician	6,000
8 Utility men	33,600
Social benefits	16,600
	$99,400

2) Bellshill Lake

1 Station superintendent	$ 9,600
4 Shift operators	26,400
1 Electrical technician	7,200
1 Electrician	6,000
8 Utility men	33,600
Social benefits	16,600
	$99,400

3) Calgary

1 Station superintendent	$ 8,400
4 Shift operators	24,000
Social benefits	6,500
	$38,900

4) Britamoil Junction

1 Station superintendent	$ 8,400
4 Shift operators	24,000
2 Utility men	8,400
Social benefits	8,200
	$49,000

5) Montreal Manifold

1 Chief operator	$ 7,800
4 Shift operators	24,000
4 Meter and utility men	24,000
Social benefits	11,200
	$67,000

Total labor excluding Main Line stations	$353,700

6) <u>Typical Main Line Station</u>

1	Station superintendent	$ 9,000
4	Shift operators	26,400
4	Utility men	16,800
	Social benefits	10,400
		$62,600

SUMMARY - SOUTHERN OR NORTHERN ROUTE

	1960-2	1963-9
	7 ~~8~~ Stations	15 ~~16~~ Stations
(1) Labor Excluding Main Line Stations	$353,700	$353,700
(2) Station Labor	438,200	939,000
Total	$792,000	$1,293,000

Note: Bellshill Lake is a Main Line station but included unter Item (1) and excluded from Item (2). Booster station is not included, as it is proposed as an unmanned remote-controlled station.

5. ESTIMATED ANNUAL TANK FARM MAINTENANCE

	TANKAGE In Barrels	
	1960-64	1965-69
1) Calgary	50,000	50,000
2) Britamoil Junction	30,000	30,000
3) Edmonton	800,000	1,100,000
4) Bellshill Lake	877,000	1,315,500
Total Barrels	1,757,000	2,495,500
Maintenance Cost per Year @ $0. 04/barrel	$ 70,000	$ 100,000

6. ESTIMATED ANNUAL PIPELINE MAINTENANCE

	SOUTHERN ROUTE	NORTHERN ROUTE
1) 73.5 Miles, 10 3/4" OD Pipe @ $250/Mile	$ 18,000	$ 18,000
2) 71.5 Miles, 16" OD Pipe @ $250/Mile	18,000	18,000
3) 100 Miles, 26" OD Pipe @ $350/Mile	35,000	35,000
4) 750 Miles, 30" OD Pipe @ $600/Mile	450,000	
4a) 110 Miles, 30" OD Pipe @ $600/Mile		66,000
5) 1169 Miles, 30" OD Pipe @ $400/Mile	468,000	
5a) 905 Miles, 30" OD Pipe @ $400/Mile		362,000
6) 890 Miles, 30" OD Pipe @ $700/Mile		623,000
TOTAL PIPELINE MAINTENANCE PER YEAR	$ 989,000	$1,122,000

7. ESTIMATED ANNUAL COMMUNICATIONS COST

Leased wire and teletype, 2164 Miles of $200/Mile per year, Southern Route	$ 433,000
2150 Miles of $200/Mile per year Northern Route	$ 430,000

8. OPERATING COSTS IN UNITED STATES, SOUTHERN SYSTEM

Station Operating Cost Within U.S. (Excluding Labor and Tankage)

Year	BHP/STATION	BHP in U.S. (3 sta. 1960-2) (6 sta. 1963-9)	Operating Cost @$59.00/BHP
1960	2185	6560	$ 387,000
1961	3052	9160	540,400
1962	4231	12690	748,700
1963	2750	16500	973,500
1964	3556	21340	1,259,100
1965	4388	26330	1,553,500
1966	5100	30600	1,805,400
1967	5881	35290	2,082,100
1968	6768	40610	2,396,000
1969	7562	45370	2,676,800

Station Labor Expense in U.S.

$ 62,600/ Main Line Station

1960-2 3 Stations	1963-9 6 Stations
$187,800	$375,600

Pipeline Maintenance - Estimated Annual in U.S.

Milepost out of U. S. = 1471.0
Milepost into U.S. = 703.5
767.5 Miles in U.S.

200 Miles, 30" O.D. Pipe @ $600/Mile	$120,000
567.5 Miles, 30" O.D. Pipe @ $400/Mile	227,000
	$347,000

Communications Cost in U.S.

767.5 Miles @ $200/Mile	$153,500

U.S. PORTION - ANNUAL OPERATING COSTS

(000 Omitted)

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
30" System										
(1) Stations, excluding labor and tankage	$ 387	$ 540	$ 749	$ 974	$1,259	$1,554	$1,805	$2,082	$2,396	$2,677
(2) Station and Terminal Labor	188	188	188	376	376	376	376	376	376	376
(3) Pipeline Maintenance	347	347	347	347	347	347	347	347	347	347
(4) Communications	154	154	154	154	154	154	154	154	154	154
Subtotal	1,076	1,229	1,438	1,851	2,136	2,431	2,682	2,959	3,273	3,554
(5) Administration	276	276	276	351	351	351	351	351	351	351
Total	$1,352	$1,505	$1,714	$2,202	$2,487	$2,782	$3,033	$3,310	$3,624	$3,905

Note: No tank maintenance in the United States

9. OPERATING COSTS IN CANADA, SOUTHERN SYSTEM

Main Line Station Operating Costs, within Canada (excluding labor and tankage)

Year	BHP/Sta. (Main Line only)	BHP in Canada (Main Line only) (5 Sta. 1960-2) (10 Sta. 1963-9)	Total BHP (Without Main Line)	Grand Total BHP	Operating Costs @$59.00/BHP
1960	2,185	10,930	1,750	12,680	$ 748,120
1961	3,052	15,260	2,323	17,583	1,037,400
1962	4,231	21,155	2,985	24,140	1,424,300
1963	2,750	27,500	3,780	31,280	1,845,500
1964	3,556	35,560	4,719	40,279	2,376,460
1965	4,388	43,880	5,848	49,728	2,933,950
1966	5,100	51,000	6,801	57,801	3,410,260
1967	5,881	58,810	7,647	66,457	3,920,960
1968	6,768	67,680	8,619	76,299	4,501,640
1969	7,562	75,620	9,634	85,254	5,029,990

Station Labor Expense in Canada

Typical Main Line Station - $62,600/year

	1960-2 5 Stations	1963-9 10 Stations
1) Labor excluding Main Line Stations	$353,700	$353,700
2) Station Labor	250,000	563,400
Total	$603,700	$917,100

Note: Bellshill Lake is a Main Line station but included under Item (1) and excluded from Item (2).

Pipeline Maintenance - Estimated Annual in Canada

1)	73.5 Miles, 10 3/4" O.D. Pipe @ $250/mile	$ 18,000
2)	71.5 Miles, 16" O.D. Pipe @ $250/mile	18,000
3)	100 Miles, 26" O.D. Pipe @ $350/mile	35,000
4)	550 Miles, 30' O.D. Pipe @ $600/mile	330,000
5)	601.5 Miles, 30" O.D. Pipe @ $400/mile	240,600
	Total pipeline maintenance cost/year	$641,600

Communications

1396.5 Miles @ $200/mile/year	$279,300

CANADIAN PORTION - ANNUAL OPERATING COSTS

(000 Omitted)

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
(1) Stations, excluding labor and tankage	$ 748	$1,037	$1,424	$1,846	$2,376	$2,934	$3,410	$3,921	$4,502	$5,030
(2) Station and Terminal Labor	604	604	604	917	917	917	917	917	917	917
(3) Tank Maintenance	70	70	70	70	70	100	100	100	100	100
(4) Pipeline Maintenance	642	642	642	642	642	642	642	642	642	642
(5) Communications	279	279	279	279	279	279	279	279	279	279
Subtotal	2,343	2,632	3,019	3,754	4,284	4,872	5,348	5,859	6,440	6,968
(6) Administration	638	638	638	763	763	775	775	775	775	775
Total	$2,981	$3,270	$3,657	$4,517	$5,047	$5,647	$6,123	$6,634	$7,215	$7,743

SUMMARY CHECK - ANNUAL OPERATING COSTS

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Operating Cost - Canada	$2,981	$3,270	$3,657	$4,517	$5,047	$5,647	$6,123	$6,634	$7,215	$7,743
Operating Cost - U.S.	1,352	1,505	1,714	2,202	2,487	2,782	3,033	3,310	3,624	3,905
Total	$4,333	$4,775	$5,371	$6,719	$7,534	$8,429	$9,156	$9,944	$10,839	$11,648

C. FINANCIAL DATA

1. DISCUSSION

a. Alternate Systems

Financial projections have been made of both 30" systems, following two different routes. The Southern Route includes a portion within the United States. Such portion has been treated herein as a separate company, subsidiary to the Canadian portion. The studies here presented are designated as follows:

1. (a) Southern Alternate - 30" System
   (b) U.S. Subsidiary - 30" System

2. Northern Alternate - 30" System

b. Financial Data and Assumptions

Basic construction costs are set out earlier in this report. From these a schedule of capital requirements and sources of capital has been prepared.

Interest during the 1958-59 construction period has been provided at 5.25%, the assumed average annual interest rate, for a period of nine months. Interest during construction on facilities constructed in later years has been provided at the rate of 2.125% which represents interest for about five months. Basic is the assumption that all new facilities will be put into operation as of the beginning of the following calendar year.

Working capital has been provided in an amount equal to 90 days or 25% of the estimated fifth year operating expense.

Line fill, a substantial item, has been assumed to be the responsibility of the pipeline and has been computed at a cost of $2.70 per barrel.

Finance expense has been provided in an amount equal to 2.027% of total capital requirements or 2.07% of such requirements exclusive of that for finance expense. This percentage

is an average for the several types of securities here involved and is patterned closely to the cost of recent issues of comparable new companies.

As sources of capital the following proportions might be assumed. Those in the first column have been used. They closely approximate those of a number of large transmission lines.

Mortgage bonds	55%	65%
Debentures	30%	20%
Common stock	15%	15%
Total	100%	100%

Quite possibly the mortgage bonds will be placed privately. The debentures and common stock likely will be sold publicly in units.

For these purposes the borrowing by both mortgages and debentures has been treated as a single debt. An average interest rate of 5.25% has been assumed. Probably that for mortgages will be a little less and that for debentures a little more.

Debt reduction has been computed as straight line annual sinking fund payments of 1/21 of the total debt beginning in the year 1963. For the purposes of computing annual interest all borrowings, subsequent to the initial 1958-59 period, and all repayments have been treated as occurring at mid-year.

Operating expense for each year is set out earlier in the report.

Advalorem or property taxes have been provided at the rate of 1.2% of initial cost of all fixed assets in Canada and 2.0% of those in the United States.

Depreciation has been computed at the composite straight line rate of 3.5% per annum on the beginning of the year investment.

Interest and amortization of finance expense is the aggregate of interest, computed as heretofore described, and amortization of finance expense at the rate of 4% per annum.

For the purposes of computing cost of service there has

been included a return of 7.5% on total investment reduced by accumulated straight line depreciation. This return is, in the cost of service schedules, the total of the columns entitled "interest" and "required net profit".

Income taxes have been provided at 47% for Canadian profits and 54% of those in the United States. Income taxes shown as expense or cost are computed on profits based on straight line 3.5% depreciation. Such taxes are divided into two categories, paid and deferred, on the assumption that taxes will be paid on profits after deducting 6.5% declining balance depreciation. This difference in book and tax depreciation affects nothing except the conservation of cash during the first ten years of operations.

c. Statements

For each alternate system the cost of service has been first computed for each of the years 1960-69, inclusive. Taking into account numerous economic factors, including the financibility of the systems, the cost of service per barrel indicated for 1964, the fifth year of operation, has been selected as an illustrative tariff.

Then, based upon such illustrative tariff and annual throughputs, provided and set out earlier in this report, pro forma financial statements for the two 30" systems have been prepared.

For cost of service and pro forma statement purposes the transportation costs through the United States portion of the Southern Alternate has been treated as a cost to the Canadian system. Thus, the Canadian system collects a tariff for the entire shipment and pays to the U. S. subsidiary the portion allocable to it. In reviewing the income statements and balance sheets of the Southern Alternate it must be remembered that profits, assets, debts, capital, etc. are reflected partly in the statements for the Southern Alternate and partly in those for the U. S. Subsidiary.

For purposes of ready comparison there follows a tabulation of the per barrel cost of service of each alternate for each year. These figures are, of course, based upon the foregoing assumptions and assumed throughputs, consistently applied.

Year	Southern	Northern
1960	$ .758	$ .812
1961	.665	.709
1962	.605	.645
1963	.553	.588
1964	.518	.548
1965	.479	.506
1966	.454	.478
1967	.438	.463
1968	.415	.437
1969	.396	.417

Hereafter there is presented for the two 30" systems the following pro forma statements:

Income and Expense

Balance Sheets

Cash Receipts and Disbursements

Capitalization

Cost of Service

Fixed Assets, Depreciation and Deferred Income Taxes

Debt Service

ALBERTA-MONTREAL PIPELINE

SOUTHERN ALTERNATE -- 30" SYSTEM

PRO FORMA STATEMENT OF INCOME AND EXPENSE

(000 OMITTED)

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Revenue	$ 37,814	$ 42,352	$ 46,889	$ 51,427	$ 55,971	$ 60,502	$ 63,603	$ 66,186	$ 69,805	$ 72,905
Revenue Deductions										
Operating Expense	2,981	3,270	3,657	4,517	5,047	5,647	6,123	6,634	7,215	7,743
Depreciation (Straight Line)	7,645	7,645	7,659	7,902	7,909	8,137	8,137	8,149	8,269	8,269
Ad Valorem Tax	2,621	2,621	2,621	2,709	2,711	2,789	2,789	2,793	2,835	2,835
Transportation Through U.S. Subsidiary	12,191	13,654	15,117	16,580	17,995	19,507	20,505	21,338	22,505	23,504
Income Taxes										
Paid					2,797	5,188	6,544	7,594	8,955	10,242
Deferred	526	1,824	3,063	3,927	2,594	1,319	994	780	424	144
Total	25,964	29,014	32,117	35,635	39,053	42,587	45,092	47,288	50,203	52,737
Net Income Before Interest	11,850	13,338	14,772	15,792	16,918	17,915	18,511	18,898	19,602	20,168
Interest and Amortization of Finance Expense	11,257	11,281	11,318	11,364	10,839	10,578	10,011	9,455	9,025	8,457
Annual Net Income	593	2,057	3,454	4,428	6,079	7,337	8,500	9,443	10,577	11,711
Cumulative Earned Surplus	593	2,650	6,104	10,532	16,611	23,948	32,448	41,891	52,468	64,179
Rate Base (Capital less Depreciation)	242,594	235,349	234,690	226,988	225,579	217,442	209,605	204,014	195,745	187,476
Return on Rate Base	4.9%	5.7%	6.3%	7.0%	7.5%	8.2%	8.8%	9.3%	10.0%	10.7%
Return on Common Stock	1.5%	5.1%	8.6%	11.1%	15.2%	18.3%	21.2%	23.6%	26.4%	29.3%
Ratio of Cash Available From Earning to Interest Expense	1.8	2.1	2.4	2.5	2.5	2.6	2.9	2.9	3.2	3.4

ALBERTA-MONTREAL PIPELINE

SOUTHERN ALTERNATE -- 30" SYSTEM

PRO FORMA BALANCE SHEETS

(000 OMITTED)

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Assets											
Fixed Assets	$218,426	$218,426	$218,823	$225,766	$225,971	$232,484	$232,484	$232,821	$236,248	$236,248	$236,248
Reserve for Depreciation		7,645	15,290	22,949	30,851	38,760	46,897	55,034	63,183	71,452	79,721
Remainder	218,426	210,781	203,533	202,817	195,120	193,724	185,587	177,787	173,065	164,796	156,527
Cash	864	9,852	21,605	36,062	41,723	47,701	53,903	60,906	67,818	76,497	86,030
Working Capital	1,262	1,262	1,262	1,262	1,262	1,262	1,262	1,262	1,262	1,262	1,262
Line Fill	24,089	24,089	24,089	24,089	24,089	24,089	24,089	24,089	24,089	24,089	24,089
Unamortized Finance Expense	5,598	5,374	5,150	4,926	4,702	4,478	4,254	4,030	3,806	3,582	3,358
Total	250,239	251,358	255,639	269,156	266,896	271,254	269,095	268,074	270,040	270,226	271,266
Liabilities and Capital											
Common Stock	40,080	40,080	40,080	40,080	40,080	40,080	40,080	40,080	40,080	40,080	40,080
Long Term Debts	210,159	210,159	210,559	217,559	206,944	202,629	191,814	181,299	173,042	162,227	151,412
Reserve for Deferred Income Taxes		526	2,350	5,413	9,340	11,934	13,253	14,247	15,027	15,451	15,595
Earned Surplus		593	2,650	6,104	10,532	16,611	23,948	32,448	41,891	52,468	64,179
Total	250,239	251,358	255,639	269,156	266,896	271,254	269,095	268,074	270,040	270,226	271,266

ALBERTA-MONTREAL PIPELINE

SOUTHERN ALTERNATE -- 30" SYSTEM

PRO FORMA STATEMENT OF CASH RECEIPTS AND DISBURSEMENTS

(000 OMITTED)

Cash Receipts	1958-59	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
From Operations											
Net Profit	$	$ 593	$ 2,057	$ 3,454	$ 4,428	$ 6,079	$ 7,337	$ 8,500	$ 9,443	$10,577	$11,711
Depreciation		7,645	7,645	7,659	7,902	7,909	8,137	8,137	8,149	8,269	8,269
Deferred Income Tax		526	1,824	3,063	3,927	2,594	1,319	994	780	424	144
Amortization of Finance Expense		224	224	224	224	224	224	224	224	224	224
Total		8,988	11,750	14,400	16,481	16,806	17,017	17,855	18,596	19,494	20,348
Borrowed Capital	210,159		400	7,000	200	6,500		300	2,558		
Common Stock	40,080										
Total	250,239	8,988	12,150	21,400	16,681	23,306	17,017	18,155	21,154	19,494	20,348
Cash Disbursements											
Construction	210,151		389	6,799	201	6,377		330	3,356		
Interest during Construction	8,275		8	144	4	136		7	71		
Line Fill	24,089										
Working Capital	1,262										
Finance Expense	5,598										
Debt Reduction					10,815	10,815	10,815	10,815	10,815	10,815	10,815
Total	249,375		397	6,943	11,020	17,328	10,815	11,152	14,242	10,815	10,815
Annual Excess of Cash Receipts	864	8,988	11,753	14,457	5,661	5,978	6,202	7,003	6,912	8,679	9,533
Cumulative Cash Balance	864	9,852	21,605	36,062	41,723	47,701	53,903	60,906	67,818	76,497	86,030

ALBERTA-MONTREAL PIPELINE

SOUTHERN ALTERNATE -- 30" SYSTEM

CAPITALIZATION

(000 OMITTED)

	1958-59	1960	1961	1962	1963	1964	1965	1966	1967	Total
Capital Requirements										
Construction	$ 210,151		$ 389	$ 6,799	$ 201	$ 6,377		$ 330	$ 3,356	$ 227,603
Interest during Construction	8,275		8	144	4	136		7	71	8,645
Total	218,426		397	6,943	205	6,513		337	3,427	236,248
Working Capital	1,262									1,262
Line Fill	24,089									24,089
Finance Expense	5,598									5,598
Total	249,375		397	6,943	205	6,513		337	3,427	267,197
Sources of Capital										
Borrowed Capital										
Mortgages	130,000		400	7,000	200	6,500		300	2,558	146,958
Debentures	80,159									80,159
Total	210,159		400	7,000	200	6,500		300	2,558	227,117
Common Stock	40,080									40,080
Total	250,239		400	7,000	200	6,500		300	2,558	267,197

ALBERTA-MONTREAL PIPELINE

SOUTHERN ALTERNATE -- 30" SYSTEM

COST OF SERVICE

(000 OMITTED)

Year	Operating Expense	Ad Valorem Tax	Straight Line Depreciation	Interest and Amortization	U.S. Subsidiary's Cost of Service	Normalized Income Tax	Required Net Profit	Total Cost of Service	MBP Yr.	Cost of Service Per Bbl.
1960	$ 2,981	$ 2,621	$ 7,645	$ 11,257	$ 17,905	$ 6,064	$ 6,838	$ 55,311	200,000 B/D 73,000	$ 0.758
1961	3,270	2,621	7,645	11,281	17,497	5,649	6,370	54,333	225,000 B/D 81,760	0.665
1962	3,657	2,621	7,659	11,318	17,691	5,573	6,284	54,803	248,000 B/D 90,520	0.605
1963	4,517	2,709	7,902	11,364	17,720	5,019	5,660	54,891	272,000 99,280	0.553
1964	5,047	2,711	7,909	10,839	17,995	5,391	6,079	55,971	108,040	0.518
1965	5,647	2,789	8,137	10,578	17,955	5,081	5,730	55,917	116,800	0.479
1966	6,123	2,789	8,137	10,011	17,876	5,063	5,709	55,708	122,786	0.454
1967	6,634	2,793	8,149	9,455	17,929	5,184	5,846	55,990	127,772	0.438
1968	7,215	2,835	8,269	9,025	17,938	5,016	5,656	55,954	134,758	0.415
1969	7,743	2,835	8,269	8,457	17,895	4,970	5,604	55,773	140,744	0.396

ALBERTA-MONTREAL PIPELINE

SOUTHERN ALTERNATE -- 30" SYSTEM

FIXED ASSETS, DEPRECIATION AND DEFERRED INCOME TAXES

(000 OMITTED)

Year	Cost		Straight Line Depreciation @ 3.5%		Declining Balance Tax Depreciation @ 6.5%		Excess of Tax Depreciation	Income Taxes Deferred	
	Addition	Balance	Annual	Reserve	Annual	Remaining		Annual	Cumulative
1958-59	$ 218,426	$ 218,426	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1960		218,426	7,645	7,645	14,198	204,228	6,553	3,080	3,080
1961	397	218,823	7,645	15,290	13,301	191,324	5,656	2,658	5,738
1962	6,943	225,766	7,659	22,949	12,887	185,380	5,228	2,457	8,195
1963	205	225,971	7,902	30,851	12,063	173,522	4,161	1,956	10,151
1964	6,513	232,484	7,909	38,760	11,702	168,333	3,793	1,783	11,934
1965		232,484	8,137	46,897	10,942	157,391	2,805	1,318	13,252
1966	337	232,821	8,137	55,034	10,252	147,476	2,115	994	14,246
1967	3,427	236,248	8,149	63,183	9,809	141,094	1,660	780	15,026
1968		236,248	8,269	71,452	9,171	131,923	902	424	15,450
1969		236,248	8,269	79,721	8,575	123,348	306	144	15,594

Until the year 1964 the deferrment of taxes and the reserve therefore on the foregoing income statement and balance sheets does not coincide with the above due to carry forward losses in early year created by tax depreciation.

ALBERTA-MONTREAL PIPELINE

SOUTHERN ALTERNATE -- 30" SYSTEM

DEBT SERVICE

(000 OMITTED)

	Principal						
Year	Net Additions (Reductions)	Balance	Interest @ 5.25%	Amortization of Finance Expense	Total	Interest Capitalized During Construction	Interest and Amortization Expense
1958-59	$ 210,159	$ 210,159	$ 8,275	$ -	$ 8,275	$ 8,275	$ -
1960		210,159	11,033	224	11,257		11,257
1961	400	210,559	11,065	224	11,289	8	11,281
1962	7,000	217,559	11,238	224	11,462	144	11,318
1963	(10,615)	206,944	11,144	224	11,368	4	11,364
1964	(4,315)	202,629	10,751	224	10,975	136	10,839
1965	(10,815)	191,814	10,354	224	10,578		10,578
1966	(10,515)	181,299	9,794	224	10,018	7	10,011
1967	(8,257)	173,042	9,302	224	9,526	71	9,455
1968	(10,815)	162,227	8,801	224	9,025		9,025
1969	(10,815)	151,412	8,233	224	8,457		8,457

ALBERTA-MONTREAL PIPELINE

U.S. SUBSIDIARY -- 30" SYSTEM

PRO FORMA STATEMENT OF INCOME AND EXPENSE

(000 OMITTED)

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Revenue	$12,191	$13,654	$15,117	$16,580	$18,043	$19,506	$20,505	$21,338	$22,505	$23,504
Revenue Deductions										
Operating Expense	1,352	1,505	1,714	2,202	2,487	2,782	3,033	3,310	3,624	3,905
Straight Line Depreciation	3,540	3,540	3,540	3,666	3,666	3,733	3,733	3,733	3,797	3,797
Ad Valorem Tax	2,023	2,023	2,023	2,095	2,095	2,133	2,133	2,133	2,170	2,170
Income Taxes										
Paid					1,533	2,784	3,490	4,031	4,727	5,391
Deferred	296	1,004	1,670	2,062	1,286	687	512	411	219	71
Total	7,211	8,072	8,947	10,025	11,067	12,119	12,901	13,618	14,537	15,334
Net Income Before Interest	4,980	5,582	6,170	6,555	6,976	7,387	7,604	7,720	7,968	8,170
Interest and Amortization of Finance Expense	4,727	4,727	4,747	4,798	4,575	4,431	4,194	3,936	3,754	3,517
Net Income	253	855	1,423	1,757	2,401	2,956	3,410	3,784	4,214	4,653
Cumulative Earned Surplus	253	1,108	2,531	4,288	6,689	9,645	13,055	16,839	21,053	25,706
Rate Base (Capital less Depreciation)	101,437	97,997	98,057	94,391	92,725	88,992	85,259	82,030	78,233	74,536
Rate of Return	4.9%	5.7%	6.3%	6.9%	7.5%	8.3%	8.9%	9.4%	10.2%	11.0%
Rate of Return on Common Stock	1.5%	5.2%	8.5%	10.5%	14.4%	17.5%	20.5%	22.6%	25.2%	27.8%
Ratio of Cash Available From Earnings to Interest Expense	1.9	2.1	2.4	2.6	2.6	2.7	2.8	3.0	3.2	3.4

ALBERTA-MONTREAL PIPELINE

U.S. SUBSIDIARY -- 30" SYSTEM

PRO FORMA BALANCE SHEETS

(000 OMITTED)

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Assets											
Fixed Assets	$101,143	$101,143	$101,143	$104,746	$104,746	$106,664	$106,664	$106,664	$108,481	$108,481	$108,481
Reserve for Depreciation		3,540	7,080	10,620	14,286	17,952	21,685	25,418	29,151	32,948	36,745
Balance	101,143	97,603	94,063	94,126	90,460	88,712	84,979	81,246	79,330	75,533	71,736
Cash	1,134	5,310	10,796	17,513	20,585	23,607	26,570	29,812	32,114	35,931	40,039
Working Capital	622	622	622	622	622	622	622	622	622	622	622
Unamortized Finance Expense	2,178	2,091	2,004	1,917	1,830	1,743	1,656	1,569	1,482	1,395	1,308
Total	105,077	105,626	107,485	114,178	113,497	114,684	113,827	113,249	113,548	113,481	113,705
Liabilities and Capital											
Capital Stock	16,693	16,693	16,693	16,693	16,693	16,693	16,693	16,693	16,693	16,693	16,693
Long Term Debts	88,384	88,384	88,384	91,984	87,484	84,984	80,484	75,984	72,088	67,588	63,088
Reserve for Deferred Income Taxes		296	1,300	2,970	5,032	6,318	7,005	7,517	7,928	8,147	8,218
Earned Surplus		253	1,108	2,531	4,288	6,689	9,645	13,055	16,839	21,053	25,706
Total	105,077	105,626	107,485	114,178	113,497	114,684	113,827	113,249	113,548	113,481	113,705

ALBERTA-MONTREAL PIPELINE

U.S. SUBSIDIARY -- 30" SYSTEM

PRO FORMA STATEMENT OF CASH RECEIPTS AND DISBURSEMENTS

(000 OMITTED)

	1958-59	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Cash Receipts											
Earnings											
Net Profit	$	$ 253	$ 855	$ 1,423	$ 1,757	$ 2,401	$ 2,956	$ 3,410	$ 3,784	$ 4,214	$ 4,653
Depreciation		3,540	3,540	3,540	3,666	3,666	3,733	3,733	3,733	3,797	3,797
Deferred Income Taxes		296	1,004	1,670	2,062	1,286	687	512	411	219	71
Amortization of Finance Expense		87	87	87	87	87	87	87	87	87	87
Total		4,176	5,486	6,720	7,572	7,440	7,463	7,742	8,015	8,317	8,608
Borrowed Capital	88,384			3,600		2,000			604		
Common Stock	16,693										
Total	105,077	4,176	5,486	10,320	7,572	9,440	7,463	7,742	8,619	8,317	8,608
Cash Disbursements											
Construction	97,311			3,528		1,879			1,779		
Interest during Construction	3,832			75		39			38		
Finance Expense	2,178										
Working Capital	622										
Debt Reduction					4,500	4,500	4,500	4,500	4,500	4,500	4,500
Total	103,943			3,603	4,500	6,418	4,500	4,500	6,317	4,500	4,500
Annual Excess of Receipts	1,134	4,176	5,486	6,717	3,072	3,022	2,963	3,242	2,302	3,817	4,108
Cumulative Cash Balance	1,134	5,310	10,796	17,513	20,585	23,607	26,570	29,812	32,114	35,931	40,039

ALBERTA-MONTREAL PIPELINE

U.S. SUBSIDIARY -- 30" SYSTEM

CAPITALIZATION

(000 OMITTED)

	1958-59	1960	1961	1962	1963	1964	1965	1966	1967	Total
Capital Requirements										
Construction	$ 97,311			$ 3,528		$1,879			$ 1,779	$104,497
Interest during Construction	3,832			75		39			38	3,984
Total	101,143			3,603		1,918			1,817	108,481
Working Capital	622									622
Finance Expense	2,178									2,178
Total	103,943			3,603		1,918			1,817	111,281
Sources of Capital										
Borrowed Capital										
Mortgages	55,000			3,600		2,000			604	61,204
Debentures	33,384									33,384
Total	88,384			3,600		2,000			604	94,588
Common Stock	16,693									16,693
Total	105,077			3,600		2,000			604	111,281

ALBERTA-MONTREAL PIPELINE

U.S. SUBSIDIARY -- 30" SYSTEM

COST OF SERVICE

(000 OMITTED)

Year	Operating Expense	Ad Valorem Tax	Straight Line Depreciation	Interest and Amortization	Normalized Income Tax	Required Net Profit	Total Cost of Service	MBP Yr.	Cost of Service Per Bbl.
1960	$ 1,352	$ 2,023	$ 3,540	$ 4,727	$ 3,382	$ 2,881	$ 17,905	73,000	$ 0.245
1961	1,505	2,023	3,540	4,727	3,079	2,623	17,497	81,760	0.214
1962	1,714	2,023	3,540	4,747	3,060	2,607	17,691	90,520	0.195
1963	2,202	2,095	3,666	4,798	2,678	2,281	17,720	99,280	0.177
1964	2,487	2,095	3,666	4,575	2,793	2,379	17,995	108,040	0.167
1965	2,782	2,133	3,733	4,431	2,633	2,243	17,955	116,800	0.154
1966	3,033	2,133	3,733	4,194	2,583	2,200	17,876	122,786	0.146
1967	3,310	2,133	3,733	3,936	2,601	2,216	17,929	127,772	0.140
1968	3,624	2,170	3,797	3,754	2,480	2,113	17,938	134,758	0.133
1969	3,905	2,170	3,797	3,517	2,433	2,073	17,895	140,744	0.127

ALBERTA-MONTREAL PIPELINE

U.S. SUBSIDIARY -- 30" SYSTEM

FIXED ASSETS, DEPRECIATION AND DEFERRED INCOME TAXES

(000 OMITTED)

	Cost		Straight Line Depreciation @ 3.5%		Declining Balance Tax Depreciation @ 6.5%		Excess of	Income Taxes Deferred	
Year	Addition	Balance	Annual	Reserve	Annual	Remaining	Tax Depreciation	Annual	Cumulative
1958-59	$ 101,143	$ 101,143	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1960		101,143	3,540	3,540	6,574	94,569	3,034	1,638	1,638
1961		101,143	3,540	7,080	6,147	88,422	2,607	1,408	3,046
1962	3,603	104,746	3,540	10,620	5,982	86,043	2,442	1,319	4,365
1963		104,746	3,666	14,286	5,593	80,450	1,927	1,041	5,406
1964	1,918	106,664	3,666	17,952	5,354	77,014	1,688	912	6,318
1965		106,664	3,733	21,685	5,006	72,008	1,273	687	7,005
1966		106,664	3,733	25,418	4,681	67,327	948	512	7,517
1967	1,817	108,481	3,733	29,151	4,494	64,650	761	411	7,928
1968		108,481	3,797	32,948	4,202	60,448	405	219	8,147
1969		108,481	3,797	36,745	3,929	56,519	132	71	8,218

ALBERTA-MONTREAL PIPELINE

U.S. SUBSIDIARY -- 30" SYSTEM

DEBT SERVICE

(000 OMITTED)

	Principal						
Year	Net Additions (Reductions)	Balance	Interest @ 5.25%	Amortization of Finance Expense	Total	Interest Capitalized During Construction	Interest and Amortization Expense
1958-59	$ 88,384	$ 88,384	$ 3,832	$ -	$ 3,832	$ 3,832	$ -
1960		88,384	4,640	87	4,727		4,727
1961		88,384	4,640	87	4,727		4,727
1962	3,600	91,984	4,735	87	4,822	75	4,747
1963	(4,500)	87,484	4,711	87	4,798		4,798
1964	(2,500)	84,984	4,527	87	4,614	39	4,575
1965	(4,500)	80,484	4,344	87	4,431		4,431
1966	(4,500)	75,984	4,107	87	4,194		4,194
1967	(3,896)	72,088	3,887	87	3,974	38	3,936
1968	(4,500)	67,588	3,667	87	3,754		3,754
1969	(4,500)	63,088	3,430	87	3,517		3,517

ALBERTA-MONTREAL PIPELINE

NORTHERN ALTERNATE -- 30" SYSTEM

PRO FORMA STATEMENT OF INCOME AND EXPENSE

(000 OMITTED)

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Revenue	$ 40,004	$ 44,804	$ 49,605	$ 54,405	$ 59,235	$ 64,006	$ 67,287	$ 70,019	$ 73,847	$ 77,128
Revenue Deductions										
Operating Expense	4,567	5,006	5,597	6,936	7,717	8,619	9,326	10,101	10,979	11,776
Depreciation	12,450	12,450	12,465	12,849	12,856	13,159	13,159	13,171	13,363	13,363
Ad Valorem Tax	4,269?	4,269	4,273	4,405	4,408	4,512	4,512	4,516	4,582	4,582
Income Taxes										
Paid					2,287	7,886	10,044	11,703	13,842	15,877
Deferred	529?	2,583	4,504	5,851	5,871	2,117	1,588	1,245	671	219
Total	21,815	24,308	26,839	30,041	33,139	36,293	38,629	40,736	43,437	45,817
Net Income Before Interest	18,189	20,496	22,766	24,364	26,096	27,713	28,658	29,283	30,410	31,311
Interest and Amortization of Finance Expense	17,592?	17,584	17,688	17,766	16,896	16,433	15,542	14,682	14,045	13,161
Annual Net Income	597	2,912	5,078	6,598	9,200	11,280	13,116	14,601	16,365	18,150
Cumulative Earned Surplus	597	3,509	8,587	15,185	24,385	35,665	48,781	63,382	79,747	97,897
Rate Base (Capital Less Depreciation)	378,571	366,121	365,656	352,807	347,951	334,792	321,633	313,527	300,164	286,801
Return on Rate Base	4.8%	5.6%	6.2%	6.9%	7.5%	8.3%	8.9%	9.3%	10.1%	10.9%
Return on Common Stock	1.0%	4.7%	8.1%	10.6%	14.7%	18.1%	21.0%	23.4%	26.2%	29.1%
Ratio of Cash Available From Earnings to Interest Expense	1.8	2.0	2.3	2.4	2.7	2.7	2.8	3.0	3.2	3.4

ALBERTA-MONTREAL PIPELINE

NORTHERN ALTERNATE -- 30" SYSTEM

PRO FORMA BALANCE SHEET

(000 OMITTED)

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Assets											
Fixed Assets	$355,732	$355,732	$356,129	$367,111	$367,316	$375,978	$375,978	$376,315	$381,797	$381,797	$381,797
Reserve for Depreciation		12,450	24,900	37,365	50,214	63,070	76,229	89,388	102,559	115,922	129,285
Balance	355,732	343,282	331,229	329,746	317,102	312,908	299,749	286,927	279,238	265,875	252,512
Cash	1,000	14,916	32,804	56,209	64,800	75,563	85,617	96,641	108,739	122,636	137,866
Line Fill	23,922	23,922	23,922	23,922	23,922	23,922	23,922	23,922	23,922	23,922	23,922
Working Capital	1,929	1,929	1,929	1,929	1,929	1,929	1,929	1,929	1,929	1,929	1,929
Unamortized Finance Expense	8,438	8,098	7,758	7,418	7,078	6,738	6,398	6,058	5,718	5,378	5,038
Total	391,021	392,147	397,642	419,224	414,831	421,060	417,615	415,477	419,546	419,740	421,267
Liabilities and Capital											
Common Stock	62,413	62,413	62,413	62,413	62,413	62,413	62,413	62,413	62,413	62,413	62,413
Borrowed Capital	328,608	328,608	328,608	340,608	323,766	314,924	298,082	281,240	269,463	252,621	235,779
Reserve for Deferred Income Taxes		529	3,112	7,616	13,467	19,338	21,455	23,043	24,288	24,959	25,178
Earned Surplus		597	3,509	8,587	15,185	24,385	35,665	48,781	63,382	79,747	97,897
Total	391,021	392,147	397,642	419,224	414,831	421,060	417,615	415,477	419,546	419,740	421,267

ALBERTA-MONTREAL PIPELINE

NORTHERN ALTERNATE -- 30" SYSTEM

PRO FORMA STATEMENT OF CASH RECEIPTS AND DISBURSEMENTS

(000 OMITTED)

	1958-59	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Cash Receipts											
Earnings											
Net Profit	$	$ 597	$ 2,912	$ 5,078	$ 6,598	$ 9,200	$11,280	$13,116	$ 14,601	$ 16,365	$ 18,150
Depreciation		12,450	12,450	12,465	12,849	12,856	13,159	13,159	13,171	13,363	13,363
Deferred Income Tax		529	2,583	4,504	5,851	5,871	2,117	1,588	1,245	671	219
Amortization of Finance Expense		340	340	340	340	340	340	340	340	340	340
Total		13,916	18,285	22,387	25,638	28,267	26,896	28,203	29,357	30,739	32,072
Borrowed Capital	328,608			12,000		8,000			5,065		
Common Stock	62,413										
Total	391,021	13,916	18,285	34,387	25,638	36,267	26,896	28,203	34,422	30,739	32,072
Cash Disbursements											
Construction	342,256		389	10,753	201	8,482		330	5,368		
Interest During Construction	13,476		8	229	4	180		7	114		
Line Fill	23,922										
Working Capital	1,929										
Finance Expense	8,438										
Debt Reduction					16,842	16,842	16,842	16,842	16,842	16,842	16,842
Total	390,021		397	10,982	17,047	25,504	16,842	17,179	22,324	16,842	16,842
Annual Excess of Cash Receipts	1,000	13,916	17,888	23,405	8,591	10,763	10,054	11,024	12,098	13,897	15,230
Cumulative Cash Balance	1,000	14,916	32,804	56,209	64,800	75,563	85,617	96,641	108,739	122,636	137,866

ALBERTA-MONTREAL PIPELINE

NORTHERN ALTERNATE -- 30" SYSTEM

CAPITALIZATION

(000 OMITTED)

	1958-59	1960	1961	1962	1963	1964	1965	1966	1967	Total
Capital Requirements										
Construction	$342,256		$ 389	$10,753	$ 201	$8,482		$ 330	$5,368	$367,779
Interest during Construction	13,476		8	229	4	180		7	114	14,018
Total	355,732		397	10,982	205	8,662		337	5,482	381,797
Working Capital	1,929									1,929
Line Fill	23,922									23,922
Finance Expense	8,438									8,438
Total	390,021		397	10,982	205	8,662		337	5,482	416,086
Sources of Capital										
Borrowed Capital										
Mortgages	203,782			12,000		8,000			5,065	228,847
Debentures	124,826									124,826
Total	328,608			12,000		8,000			5,065	353,673
Common Stock	62,413									62,413
Total	391,021			12,000		8,000			5,065	416,086

ALBERTA-MONTREAL PIPELINE

NORTHERN ALTERNATE -- 30" SYSTEM

COST OF SERVICE

(000 OMITTED)

Year	Operating Expense	Ad Valorem Tax	Straight Line Depreciation	Interest and Amortization	Normalized Income Tax	Required Net Profit	Total Cost of Service	MBP Yr.	Cost of Service Per Bbl.
1960	$ 4,567	$ 4,269	$ 12,450	$ 17,592	$ 9,577	$10,801	$ 59,256	$ 73,000	$0.812
1961	5,006	4,269	12,450	17,584	8,756	9,875	57,940	81,760	0.709
1962	5,597	4,273	12,465	17,688	8,633	9,736	58,392	90,520	0.645
1963	6,936	4,405	12,849	17,766	7,709	8,694	58,359	99,280	0.588
1964	7,717	4,408	12,856	16,896	8,158	9,200	59,235	108,040	0.548
1965	8,619	4,512	13,159	16,433	7,693	8,676	59,092	116,800	0.506
1966	9,326	4,512	13,159	15,542	7,608	8,580	58,727	122,786	0.478
1967	10,101	4,516	13,171	14,682	7,832	8,833	59,135	127,772	0.463
1968	10,979	4,582	13,363	14,045	7,508	8,467	58,944	134,758	0.437
1969	11,776	4,582	13,363	13,161	7,403	8,349	58,634	140,744	0.417

ALBERTA-MONTREAL PIPELINE

NORTHERN ALTERNATE -- 30" SYSTEM

FIXED ASSETS, DEPRECIATION AND DEFERRED INCOME TAXES

(000 OMITTED)

Year	Cost		Straight Line Depreciation @ 3.5%		Declining Balance Tax Depreciation @ 6.5%		Excess of Tax Depreciation	Income Taxes Deferred	
	Addition	Balance	Annual	Reserve	Annual	Remaining		Annual	Cumulative
1958-59	$355,732	$355,732							
1960		355,732	$12,450	$12,450	$23,123	$332,609	$10,673	$5,016	$5,016
1961	397	356,129	12,450	24,900	21,645	311,361	9,195	4,322	9,338
1962	10,982	367,111	12,465	37,365	20,952	301,391	8,487	3,989	13,327
1963	205	367,316	12,849	50,214	19,603	281,993	6,754	3,174	16,501
1964	8,662	375,978	12,856	63,070	18,893	271,762	6,037	2,837	19,338
1965		375,978	13,159	76,229	17,664	254,098	4,505	2,117	21,455
1966	337	376,315	13,159	89,388	16,538	237,897	3,379	1,588	23,043
1967	5,482	381,797	13,171	102,559	15,820	227,559	2,649	1,245	24,288
1968		381,797	13,363	115,922	14,791	212,768	1,428	671	24,959
1969		381,797	13,363	129,285	13,830	198,938	467	219	25,178

Until the year 1964 the deferment of taxes and the reserve therefore on the foregoing Income Statement and Balance Sheets does not coincide with the above due to carry forward losses created by tax depreciation.

ALBERTA-MONTREAL PIPELINE

NORTHERN ALTERNATE -- 30" SYSTEM

DEBT SERVICE

(000 OMITTED)

	Principal						
Year	Net Additions (Reductions)	Balance	Interest @ 5.25%	Amortization of Finance Expense	Total	Interest Capitalized During Construction	Interest and Amortization Expense
1958-59	$328,608	$328,608	$13,476	$	$13,476	$13,476	$
1960		328,608	17,252	340	17,592		17,592
1961		328,608	17,252	340	17,592	8	17,584
1962	12,000	340,608	17,567	340	17,917	229	17,688
1963	(16,842)	323,766	17,440	340	17,770	4	17,766
1964	(8,842)	314,924	16,736	340	17,076	180	16,896
1965	(16,842)	298,082	16,093	340	16,433		16,433
1966	(16,842)	281,240	15,209	340	15,549	7	15,542
1967	(11,777)	269,463	14,456	340	14,796	114	14,682
1968	(16,842)	252,621	13,705	340	14,045		14,045
1969	(16,842)	235,779	12,821	340	13,161		13,161